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GENERAL SIR HARRY N. D. PRENDERGAST, V.C., K.C.B., in the Chair.

UNIVERSAL COMPULSORY SERVICE FOR THE UNITED KINGDOM.

By Major-General F. H. TYRRELL, Madras Army.

"SELF-PRESERVATION is the first law of nations, as it is of individuals," and this self-preservation is to be ensured by a nation only through its military and naval efficiency.

The present age has witnessed a stupendous change in the nature of military organization. Thirty years ago the civilized nations of Europe relied for their protection upon standing armies of professional soldiers, kept always on foot, and forming a class apart from the civil population. To-day, in the great nations of the Continent, the distinction between the soldier and the civilian, between the army and the nation, exists no longer. Every able-bodied man has been trained as a soldier, and is ready to take his place in the ranks, and the army is the nation in arms. I propose in this paper to examine the reasons for this radical change, and to recount briefly the means by which it has been brought about, and also to inquire into the probability or possibility of the people of this kingdom preserving their exemption from the burden which necessity has imposed upon all other civilized nations.

The liability of the citizen to military service is no new invention, however: it was the first basis of military organization with which history makes us acquainted. The normal state of primitive man is not peace, but war, as we may see exemplified in the life of the Bedouin tribes of the present day, and in the condition of the New Zealanders and other savages when their countries were first discovered by Europeans. In the early stages of society there is no distinction between the soldier and the hunter or the husbandman: every man takes up his rude weapons, either to defend the family or the tribe, or to dispossess troublesome neighbours of coveted and disputed water springs and pasture lands.

In the earliest historical records known to us, we find the children of Israel numbered by "every male from twenty years old and upward, all that were able to go forth to war." After the battle of the four kings with the five, the first, perhaps, recorded in history, we find the Patriarch Abraham has no difficulty in improvising an army from his shepherds and herdsmen to wrest the spoils of victory from the conquerors. It is true that in the kingdoms of Egypt and of India, which had attained to a considerable degree of material civilization before the dawn of history, we find a separate soldier class or caste already set apart for the service of war; and we shall see this separation always accompanying the growth of wealth and luxury, and the development of the civilized state.

In the Grecian Republics, in which we perceive the germs of our modern political systems, and in which the principles of free institutions were first developed, the liability of every citizen to bear arms in defence of the commonwealth was legalized, and his service was defined and organized.

Some of these States had systems of army organization as complex and as complete as those of our own day.

The Spartans were permanently enrolled in bodies answering to our brigades, battalions, companies, and squads; the men of the same squads messed together and lived together in peace as well as in war. They were enrolled at 20 years of age, and were not released from the obligation to serve until they had reached the age of 60.

The Athenian citizen was enrolled at 18: for the first 2 years of his service he was considered a recruit, and was not liable to be sent abroad; from the age of 20 to 40 he was liable for both home and foreign service; his total period of service was 22 years.

The Roman was liable to serve for 30 years, between the ages of 17 and 46. The tactical division of the Legion into Hastats, Principes, and Triarians, was based on difference of age, like the three bans or classes of the new departure in military organization, called by the Germans Active Army, Landwehr, and Landsturm.

In the ancient world, military service was an obvious duty owed by every able-bodied member to the State, and no more capable of question than the obligation to pay taxes. In the Roman Republic only paupers and beggars were exempt from military service: having no stake in the country, they were not called upon to defend it.

This system of national armies was gradually superseded by a system of mercenary standing armies. Mercenary soldiers seem to have been first employed by the Semitic nations, who engaged troops of Aryan and Turanian blood to serve them in their wars: for it is one of the characteristics of the Semitic race, that it has always proved incapable of a high type of military organization. Thus we find the Hebrew King David employing Cretan or Carian Philistines as soldiers and in his Royal body guard. The Arab Khalifs of Baghdad employed Turkish mercenaries, and the Sultans of Egypt and Syria opposed the crusading hosts with an army of Mamluks. The Semitic Carthaginians, who ruled over an Empire which, in point of extent

and colonial and commercial prosperity, shows a curious analogy to our own Empire, were the first to employ mercenaries on a large scale —Greeks, Italians, and Spaniards, all served under their banner. The practice soon spread to other States; soldiering became a trade; and then, by a natural process, a separate trade. From mercenary bands to standing armies was a natural transition, and the first standing army in Greece was established by Philip of Macedon.

The same process took place among the Romans, the stress of distant wars and foreign service leading them gradually to replace their popular army by a standing army, recruited for long service, and quartered in permanent garrisons. Thus, throughout the ancient civilized world of the Roman Empire, national armies were replaced by mercenary bands, and these, again, developed into standing armies; and we shall find this process exactly reproduced in the history of mediæval and modern Europe.

The overthrow of the Roman Empire by the Goths, Vandals, and other northern nations, plunged the world back into barbarism; and the process of civilization had to be commenced anew. In the new order of things every free man owed military service to his immediate superior. The feudal system established society on a military basis, and all land was held, and all profit and privileges enjoyed on condition of the fulfilment of military service. Again, the distinction between soldier and civilian was unknown, and the profession of arms was the universal calling.

The gradual growth of culture and civilization produced its usual effect in the division of labour, and the feudal levies were by degrees replaced by a class of professional trained soldiers.

Perhaps the organized bodies of military monks, such as the Orders of the Knights Templars and Knights Hospitallers, instituted in the Crusades, supplied the first point of the new departure. Afterwards we find the White Company of the Catalans, the Free Companies of the time of the Black Prince, the Black Bands of the Constable de Bourbon, and similar organized bodies of mercenaries playing an increasingly important part in all the wars of Europe, and setting the example of the standing armies into which they at length actually grew.

It seems hardly credible to us, seeing the absolute incapacity of the Ottoman Turks in military organization in these days, that they should have introduced the first standing army into Europe; but they had such an army, fairly well organized, and including an artillery corps, long before the institution of a similar force in any European State; and to this army the permanence of their conquests and the duration of their power are principally due. Owing to their adoption of the principle of universal liability to military service (which has just been re-introduced into the Turkish Empire in its modern form, under the auspices of German officers), they were able to bring armies into the field which far outnumbered those raised under the feudal system in European countries. Their early genius for war was probably a legacy from their Tartar ancestry; for we find in the armies of cavalry with which Changhiz Khan and his successors overran all

Western Asia and Eastern Europe in the thirteenth and fourteenth centuries, a cardinal instance of a national army organization in an Oriental nation, based on a simple decimal system. All the able-bodied men of the Mongol nation were mustered in squads or messes of ten men, nine of whom obeyed the orders of the tenth, who was On-báshi or Decurion; ten of these squads formed a squadron, the senior On-báshi commanding it in addition to his own squad; ten squadrons were united into a regiment, the senior Yuz-báshi or Captain, commanding his own squadron and the other nine, as Min-báshi (chief of a thousand); the commands of ten Min-báshis formed a Tomán or division, and the commands of ten Tomán-báshis formed an Urdu (*anglicè* Horde) or army corps, the senior Tomán-báshi being the Orlok or Corps Commander; there were ten of these Urdus, making in round numbers a million of men in all, the Orloks who commanded them taking their orders direct from the Monarch, who commanded the tenth in person. Thus from the Commander-in-Chief to the corporal of a squad there were only six grades in the military hierarchy, and six stages by which orders were personally passed from army headquarters to the mass of the soldiery. It would be impossible to devise a simpler system, or one better suited to transform a nomadic and pastoral nation into an army.

The arrangement by which a commander of a larger unit also commanded and formed part of one of the smaller units included in it, is noteworthy; for we find the same practice adopted in the organization of the Turkish janissaries, and also in the standing armies of Europe; in which, at first, a Colonel commanded one of the companies in his own regiment, and a General Officer was also Colonel of a regiment; the latter practice has survived in our own army to this day. But the military spirit which animated the Turanian nations in that epoch seems to have been short-lived, perhaps fortunately so for the rest of the world.

The superiority of the trained professional soldier to the feudal vassal taken from the sheep-cote or the plough-tail, led to the gradual substitution of mercenary for feudal armies; and the invention of fire-arms hastened the transformation.

Charles VIIth of France was the first to entertain companies of men-at-arms for the service of the State. Mercenary Captains, like Tilly and Wallenstein, raised whole armies of horse, foot, and dragoons, and hired their services to the highest bidder. These were gradually superseded by Royal standing armies, and Sweden became one of the great Powers of Europe, simply through her fine army, which had been brought to a high pitch of excellence by her King Gustavus Adolphus, the first soldier of his age. England was the last nation in Europe to adopt the institution of a standing army; except Poland, which never adopted it at all, and which, in consequence, lost her name and place among the nations. Oliver Cromwell had made himself absolute master of Great Britain and Ireland by means of his formidable army; and this fact, and the knowledge of what had already occurred on the Continent, had strongly prejudiced the English people against the institution of a regular military force.

The first use which Charles Vth of Spain had made of his new standing army was to overthrow the ancient popular liberties and parliamentary institutions of the Spanish people; and a similar fate had overtaken Bohemia and some of the German States at the hands of the Imperial army of Wallenstein. The famous army of the Duke of Alva had destroyed the liberties of the Netherlands. Everywhere a standing army was justly regarded as the instrument of monarchical despotism and absolute power. And for this very reason the Stewart Kings, Charles IInd and James IInd, acting under the advice of Louis XIVth, were anxious and eager to establish a standing army in England. All political parties in the United Kingdom were for once unanimous in opposition to the innovation. They regarded a regular army as unconstitutional, un-English, and unnecessary. Many of the speeches and diatribes uttered against its introduction were pointed by an allusion to the Turkish janissaries, who, in the words of the contemporary writer, Knolles, "Being now grown proud and lazie, as is the manner of men living in continuall pay, with armes in their hands, doubt not to doe whatsoever unto themselves seemeth best, be it never so foule or unreasonable."

But when James IInd had been dethroned and expelled, and under William IIIrd the British nation found itself opposed to the might of France, wielded by the *Grand Monarque*, the objections to the maintenance of a standing army were soon waived. France already possessed a large standing army, and to meet her on anything like equal terms, it was necessary that Great Britain should possess one too. When it came to making a choice between a standing army and defeat and national degradation, the nation was not long in making up its mind. The annual renewal of the Mutiny Act and the Articles of War by Act of Parliament still testifies to the precaution with which the change was adopted, and to the fears of its consequences, which were certainly and fortunately not verified by events.

In the struggle between James IInd and the nation, the army had taken the popular side, nor has it ever since given occasion for the suspicion with which it was at first not unnaturally regarded.

The Militia, which up to this time was the sole constitutional force in the United Kingdom, was still filled by compulsory service. The great nobles and country gentlemen had ceased to render military service to the State, though they still held the lands, and continue to hold them to this day, which had been granted to them on tenure by such service.

The new army was recruited entirely by voluntary enlistment, as were all the standing armies of the Continental nations, as well as the mercenary bands and free companies which had preceded them. During the sixteenth and seventeenth centuries there was little difficulty in attracting soldiers to the colours. Armies were small, pay was good, plunder was allowed, and discipline was slack. Enlistment was for life or for long periods, for it was the policy of rulers to form the soldiery into a class apart from the general population. As the armies grew larger, the pay grew smaller; as the principles of

efficiency became better appreciated in the constant struggle for superiority, the bonds of discipline became tightened, and drill and duty became more severe. The need for recruits and the difficulty of getting them increased in inverse ratio. Large bounties were paid; in Prussia as much as 30 dollars to every recruit on enlistment. Crimps were freely employed, and recourse was had to kidnapping and pressgangs. In England, poachers and vagabonds were given the choice of going to gaol or enlisting in the army.

It is to Prussia that we owe the first inception, as well as the full development, of the present all-embracing system of recruitment.

King Frederick William, the father of Frederick the Great, has been called a military madman by some historians; but there was a great deal of method in his madness. He steadily pursued the policy of his house, which was, to raise Prussia, by means of military strength, to the position of a first-class Power—as Sweden had been raised before. To this end he continually augmented his already formidable army. But, in spite of his extensive kidnapping operations, which he carried on so impartially as to continually embroil himself with neighbouring States, he found himself unable to fill the ranks of his increased army by the ordinary methods of enlistment.

He, accordingly, instituted conscription in the year 1733—the first instance of its application—unless in Russia, where the nobles and landholders may have been sometimes indented on for supplies of serfs to fill the ranks of the newly-formed regular army.

The Prussian dominions were mapped out into cantons, each of which was to supply a number of recruits sufficient to keep up the strength of a regiment of cavalry or infantry, or a battery of artillery. A canton of 1,800 hearths or families was allotted to each cavalry regiment, and one of 5,000 hearths to each regiment of foot.

Property above a certain amount constituted an exemption; and it was laid down by regulation that an only son was not to be taken, "unless he be an extra-fine and tall fellow."

This measure provided the troops with which Frederick the Great faced Europe in arms; but voluntary enlistment, crimping, and kidnapping were carried on alongside of it.

The conscription was very unpopular in Prussia, and, instead of being improved and extended, the system was so marred and mutilated by successive exemptions that, by the end of the eighteenth century, it had almost ceased to be operative. Whole towns and districts were granted exemption *en masse* as a mark of Royal favour; besides, whole classes of the general population, such as the nobility, all merchants and manufacturers, sons of civil officials, all the clergy, all students and artists, farmers, miners, and Jews.

This conscription, in spite of its imperfect administration, sufficed to keep the Prussian army numerically superior to all other armies on the Continent up to the time of the French Revolution. One of the first proposals made in the French Constituent Assembly was for the adoption of the practice of the ancient Greeks and Romans in making all citizens liable to military service; but the Republicans rejected the measure as inconsistent with personal liberty.

When the allied monarchs of Europe assailed the infant Republic on all her frontiers at once, all the youth of France sprang to arms, and enrolled themselves as volunteers; but, after the first fervour of enthusiasm had subsided, and the tide of invasion had been rolled back, it became difficult to keep up the supply of recruits, and forced levies had to be resorted to. The French armies had out-grown voluntary enlistment altogether, and, in 1798, a law was passed establishing the conscription in France.

A regular and methodical system was inaugurated under the direction of Carnot, by which a constant stream of conscripts annually joined the colours, and which enabled Napoleon to bring into the field the enormous hosts with which he successively crushed all his rivals and enemies. All the other nations of Europe, in order to render themselves a match for the French, were obliged to copy their methods, and conscription became the recognised means of recruiting armies. Voluntary service now almost disappeared altogether, as also did the less to be regretted crimps and pressgangs. England alone, secure in the supremacy of her navy, and safe behind the obstacle of the "silver streak," contented herself with the old method of recruiting her regular army; though the whole youth of the country was for some years under arms as volunteers ready to repel the threatened invasion of Napoleon.

Under the system of conscription, the numerical strength of standing armies was doubled and trebled. Under the Bourbon Monarchy the French army had mustered 150,000 men; with conscription it rose, under Napoleon, to half a million; and a corresponding increase had taken place in the armies of the other Continental Powers. Still, these numbers were capable of further expansion: and it was Prussia, as usual, who devised the means for a fresh increase.

After the overthrow of the Prussian army and monarchy at Jena and Auerstadt, Napoleon sought to cripple the power of his vanquished foe for revenge, by stipulating that the Prussian army should for the future be limited to the number of 40,000 men. The condition was, per force, agreed to; but the Prussian Ministers applied themselves to evolving a means of evading it in the spirit, while obeying it in the letter.

The result was the invention of the short service and reserve systems, which were elaborated by Von Scharnhorst, who was a born organizer of victory, and who performed the same service for army organization in Prussia as Carnot had already done in France.

By limiting the service with the colours to three years, he passed the whole Prussian male population through the military mill.

One-third of the army was renewed every year, so that, when Napoleon's *grande armée* had been destroyed in the retreat from Moscow, and Prussia joined Russia against the common arch enemy, by calling up her reserves, she at once placed in line a large army of seasoned soldiers, who, by sheer physical strength, overthrew, on the fields of Kulm and the Katzbach, the gallant but immature striplings whom Napoleon had called up, by discounting the drafts of the conscription for several years in advance, to fill his shattered ranks.

After the general peace of 1815, the system of Scharnhorst still remained in force in the Prussian army, though, like the conscription instituted by King Frederick William, it was not very rigidly maintained, nor very rigorously enforced. But a time came when there arose men who saw what a tremendous engine it put into their hands for the accomplishment of their political ends. The late Emperor William, first as Commander-in-Chief of the Prussian army, and afterwards as King of Prussia, with Von Bismarck as his civil, and Von Moltke as his military adviser, in pursuance of the "blood and iron" policy, carried out the system which Von Scharnhorst had invented to its logical conclusion, and made of Prussia truly a nation in arms. And this in the teeth of the obstinate opposition of the Liberal and Progressive party in the State, an opposition as short-sighted as it was violent, for surely the making of the army synonymous with the nation was the greatest triumph ever scored to the cause of Democracy.

The social and political consequences of this new departure in army organization, whereby the army is simply the nation in arms, have not yet fully developed themselves, and the peoples appear to be as yet unconscious of the power that has been newly put into their hands; but it will surely be impossible hereafter for any ruler, or set of rulers, to pursue a line of policy in opposition to the wishes of the nation. Formerly a monarch could act independently, secure in the support of a trained and disciplined body of men, isolated from the rest of the nation, and before whom the unarmed, untrained, and undisciplined masses of the civil population were helpless; but now the nation and the army have become one body, and what the former thinks and wishes the latter will do.

But military tradition, the aristocratic influence of the corps of officers, and the ancient prejudice against armies as instruments of despotism, have hitherto prevented politicians from appreciating the change which has taken place.

We thus see that military organization has moved in a circle, and has now arrived again at the point of departure whence it set out, viz., the universal liability of the citizens to serve the State in arms, through all the recurring stages of national armies, mercenary armies, feudal armies, standing armies, back to national armies again.

And the causes by which these changes were successively brought about can easily be traced. As the establishment of standing armies on the Continent necessitated their institution in England; as the introduction of conscription in France forced all the Continental Powers to adopt the same measure; so the establishment of universal compulsory service by Prussia compelled all the other nations of Europe to follow in her footsteps. In the days of voluntary enlistment, armies had been counted by tens of thousands; under the system of conscription they were reckoned by hundreds of thousands; under the new departure they are numbered by millions.

At the time of the Crimean War, the last European war in which our country was engaged, the aggregate strength of the armies of the great Powers of Europe did not exceed three millions in round

numbers; to-day it is more than twenty millions. Without including the final reserves, and only reckoning those men who have been thoroughly trained as soldiers, and are liable for service beyond the frontiers, Russia has in round numbers five millions of men; France and Germany, four millions; Austria, two and a-half millions; Italy, two millions. And these numbers are being continually increased. Quite lately France, by lengthening the duration of liability to service from a period of twenty to twenty-five years, made an enormous addition to her military strength; and the present German Army Bill contemplates a large increase in the strength of the German Army.

England remains the only great European Power which has not adopted and utilized this means of obtaining increased military strength. Owing to her insular position, and her reliance chiefly on naval power, her army was always numerically weak as compared with those of other Powers; and the adoption of the principle of conscription by the Continental nations left England still further behind. In the French Revolutionary wars, we had Germans, Portuguese, French Royalists, Greeks, &c., in our pay as soldiers. During the Crimean War we had to supplement our army with a German Legion, and with a Turkish contingent. Since then we have certainly gained a large accession of military strength. Our regular army has been but slightly increased, but we have raised for home defence a Volunteer force more than 200,000 strong. Still, when all is said and done, our total armed strength, including regulars, reserve, Militia, Volunteers, Colonial Corps, and the Indian Army is, in round numbers, not more than 700,000 men, and this number is not susceptible of any immediate or speedy augmentation. Moreover, this force is scattered up and down over the face of the globe, while Russia, France, or Germany could, with comparatively little trouble and preparation, direct a million of men on any given point within their reach.

Were our possessions, as formerly, inaccessible to our possible rivals and adversaries except by sea, we could still afford to ignore their enormously increased preponderance of military strength; but this is no longer the case. Both along the northern frontier of India, and in Egypt, we are vulnerable to a land attack. We may remember that in days when steam did not exist as a motive power, a French fleet landed a large French army in Egypt, in spite of an English fleet cruising in the Mediterranean to intercept it. In defence of our own interests, we shall assuredly be again involved some day in a European war, and shall, perhaps, have to defend India and Egypt against attack by land. Formerly we could rely upon the superior quality of our troops, and on our command of the sea, although the enemy's forces outnumbered ours by two or three to one; but now that the proportion has risen to ten to one, we must confess ourselves distanced altogether. If we were now engaged in a war with any great Continental Power, within six months we should find our operations brought absolutely to a standstill for want of men to carry them on.

Now the question is, whether it would not be wise, "Now, while the swords are a moment still, ere ever fresh blood shall run," to

take such steps as shall put us absolutely beyond the danger of falling as Venice and Holland fell, beneath the sudden blows of an enemy? Both of these States were once leading Powers in Europe; their greatness, like ours, was based on commercial prosperity and maritime ascendency; and they both fell through deficiency of military power. Unless we keep pace with other nations in this respect, we may experience their fate; we might, like Carthage, adopt the policy of defending our foreign possessions by an army of mercenaries, but we could not improvise such a force on the spur of the moment in our hour of need. Putting this measure aside as undesirable, there are three courses open to us:—

1st. To establish the Prussian system of universal compulsory service in the United Kingdom.

2nd. To adopt a modification of it suitable to our environment, as has been done by Switzerland and other nations.

3rd. To continue as we are, and trust entirely to our assured naval superiority for success in military operations.

Let us examine these courses separately. The skeleton machinery for the introduction of universal compulsory service already exists in our recently introduced territorial organization. It would be necessary to greatly augment the number of battalions in order to utilize the number of recruits available.

The distinction between Militia and Volunteers would cease. The Militia would form the Reserve, the men being transferred to its battalions from the active army.

Men might be dismissed to their homes on permanent furlough from the active army, after being certified efficient, to a much greater extent than is allowed in foreign armies, as the same reason for keeping the active army to full strength would not exist here.

Foreign service in Indian and Colonial garrisons should be provided for by a special army, as in the case of the Dutch colonial army, recruited by long-service volunteers. Foreign service battalions might be affiliated to territorial regiments and take their tour of home service.

The initial expense of providing quarters and equipments for so many additional men would be very heavy. We should save the pay of our present Reserve men, but it would probably not be possible to make much reduction in the pay of the active army. No doubt England could afford the expenditure, considering it as an insurance premium, just as well as France and Germany, and much better than poor countries like Russia and Italy. But the measure would cause a very heavy increase of expense in our military budget.

With regard to the personal aspect of the question, the State has as much right to the personal service of its members as to their pecuniary aid, and a citizen might as well refuse to pay taxes as refuse to render military service. Englishmen would surely not be so selfish as to grudge their country the service which is freely and cheerfully given by Frenchmen and Germans.

As a matter of fact, compulsory service is in force in the Channel Islands Militia, and is not found to be an intolerable hardship by the

population of those islands. Compulsory service in the Militia in the United Kingdom would still be legal, though the practice of enforcing it has fallen quite into disuse.

The Government of the United States of America, where personal liberty is valued as highly as in any country, found itself obliged to resort to compulsory service, in order to carry on military operations against the Seceded Confederate States thirty years ago. Some of the people resisted the enforcement of the draft, but it was a question of either discontinuing the war or of enforcing compulsory service, and there was no hesitation; the resistance to the draft was put down by armed force.

One common objection to compulsory service is that it is a tax on labour; that it withdraws hands from the work of production, and cripples the industry of a country.

This argument would cut the other way in England, for here we suffer from a redundancy of hands, and an insufficiency of work for them to do. A measure that would take 200,000 pairs of hands off the labour market every year ought to prove a panacea for the woes of the unemployed. I must say, I never see a knot of sturdy "corner-men" loafing at the door of a public-house without reflecting that even the pressgang could not have been an unmixed evil.

Our Indian Empire would afford a teeming harvest to the recruiting officer's sickle under a law of compulsory service. We might there raise such hosts of men as would revive the memories of the Mogul armies of Tamerlane and Aurangzebe, and make even the Russian muster-rolls look small in comparison.

The geographical and ethnographical conditions of India would render the introduction of a compulsory service system easy in most parts of that country; and the enormous fecundity and variety of the human harvest would enable great latitude to be indulged in, in humouring the prejudices of caste, creed, and hereditary habits, which would have to be combated at first.

The Russians, when introducing universal compulsory service into the Crimea and the Caucasus, at first allow the inhabitants to commute it for a money payment, and after the people have become, in a measure, habituated to it, they gradually reduce the exemptions, until at last they abolish them altogether. We have just seen a large emigration of Tartars from the Crimea into Turkey to escape service in the Russian army; they are probably jumping from the frying-pan into the fire, as universal liability to military service has lately been introduced into the dominions of the Sultan. But their objection to the Russian service perhaps arises from the dislike of the Mussulman to serve under a Christian flag, an objection which does not exist in India.

The chief obstacle to the efficiency of a territorial army in India would be the same as that which exists in Russia: the want of capable and qualified officers in sufficient numbers to officer it.

Finally, universal compulsory service entails heavy sacrifices on a nation; but is there any sacrifice a nation like the English will not undergo, in order to retain its position, its power, and its prosperity?

Still, it has yet to be proved to the conviction of the British people that such a sacrifice is necessary.

We have seen that the nation was strongly opposed to the establishment of a standing army; but it ceased its opposition at once when it found that it could combat its French rival with no other instrument; and, in the same way, if Great Britain finds her choice lie between universal compulsory service and the abdication of her national greatness, there is no manner of doubt which she will choose.

But a second course is open to us, that of adopting a compromise between the Prussian system and our present one. Our Regular army might stand as it is, and service in a territorial Militia be made compulsory on all men between the ages of from 20 to 30 or 40 years. This measure might be carried out on the lines of the present Volunteer Force, the men being only obliged to qualify as efficients, as is now required of the Volunteers, and drawing no pay, only their actual expenses being paid and their equipment provided by the State. This would be a comparatively cheap method of national insurance, and in case of a dangerous crisis we should have no lack of volunteers for foreign service, armed, equipped, organized, and partially trained. And with the nation thus armed, we could afford a Channel tunnel without any alarm at the possible dangers arising therefrom.

Examples of this kind of national defence may be seen and studied in the Militia systems of Switzerland, Sweden and Norway, and Roumania.

The third course open to us is to continue our present system, and to trust to our Fleet, the length of our purse, and the favours of fortune to pull us successfully through a conflict with the lords of legions. And, to judge from the lessons of history, this system will probably be persevered in until it has been condemned by the verdict of experience and shattered by the shock of adversity; for nations, like individuals, are generally wise after the event.

I have not ventured on any details of these schemes for the application of universal compulsory service to the United Kingdom, the outlines of which I have briefly indicated; because, until its general principle is accepted, there is no use in entering into details.

Nor have I mentioned the social and moral aspects of the question, concerning which there is much to be said on both sides.

Its advocates affirm that the system inculcates national habits of order, punctuality, endurance, and subordination; that it mitigates class distinctions, encourages mutual reliance, and welds the nation into a homogeneous mass.

Its opponents, on the other hand, maintain that the celibate life of the soldier in barracks forms and encourages habits of drinking, gambling, and indulgence in other forms of vice; and that these habits, as well as the break in the continuity of his ordinary labour, tend to diminish his subsequent usefulness as a member of the community.

I have not sufficient *data* to work upon to draw any conclusion as

to which of these opposing views is the most truthful: probably there is some truth in both of them. But, judging from my own imperfect observations, I am led to infer that the ultimate result of universal military service must be, on the whole, beneficial to humanity.

Major-General DASHWOOD: There are one or two points in this interesting lecture that I would like to make a few remarks upon. The lecturer does not agree with the system of mercenaries, and says that they are very undesirable. think at the present day they are not only undesirable but impossible, because the countries from which we got mercenaries at the time of the Crimean War, the German States and others, are now entirely closed against us, and we could not raise a man there. We tried at that time to enlist men in the United States, but the United States objected, although they got a great many men from Canada at the time of their own civil war. I think, therefore, that we must put mercenaries altogether out of the question. With regard to the Militia I do not know whether the lecturer means to say that the Militia as it is now established should be done away with, and should be merely made up of Reserve men. If so, I cannot agree with him for this reason: That now the Militia is a force which gets a great many men who live in one county, and could not afford altogether to leave the country. Therefore they join the Militia. They do so, many of them, for the purpose of having what they term "a lark" when they go out for their 28 days; in fact, I know that in the Nottinghamshire Militia Regiment men have been known to pay 1*l.* a week for people to do their work whilst they themselves went out with the Militia for their 28 days' holiday. So that if you want to do away with the Militia altogether as it is constituted, and merely to make it a force of Reservists, you would lose the men who now join the Militia. If, on the other hand, the lecturer means that the Reservists should join the Militia in addition to men now in it, I should agree with him; but, at the same time there is this to be said, that if you send the Reservists to the Militia regiment belonging to their battalion, seeing that to a great extent the territorial system is more or less a paper one, it would be rather difficult if the Militia came out to collect reserve soldiers from various parts of the country, as many do not belong to their territorial district. With regard to the Reservists, I think there is one great mistake made at the present time, that is, that we send our men to the Reserve too soon, and when they have joined that force we do not keep them long enough. Most men now enlist for 12 years, to serve partly in the Reserve and partly with the Colours, and after that date we have no further lien on them, so that if they enlist at the age of 18 or 20, at the age of 32, at all events, they have quitted the Service, unless they re-engage to serve with the Colours. I consider that a man at the age of 32 is not very much older, as far as his strength goes, than he was when he first enlisted at the age of 20; at any rate, he is not done up by any means, and is good for nine years' more service. I think, therefore, that if he were kept in the Reserve longer, say another six or nine years, and you gave him a deferred pension at a certain advanced age, we should have our Reserve very much larger than it is now. At the present moment, I believe, if we had to send out a large expedition anywhere it would take pretty nearly the whole Reserves in order to fill up our regiments. We cannot look upon the army in India as a reserve, because if we were at war with Russia we could not move a man from India. Then with regard to the advantages of conscription, no doubt there are very many. It is said, for instance, that the result of conscription would be that the population would be very much improved, owing to the men who joined the army being well fed, well clothed, and living open-air lives, and being under discipline. We all agree on that point, but I go further and say that any man, whether he be the son of a duke or a dustman, is improved by service in the army. The question we have to consider is whether we can enforce compulsory service in this country. That is a point that entirely depends on the people of this country. People get up and make after-dinner speeches about the army, and they say the country will never stand conscription. What does that mean? It means this, that if this country were in very great

stress, and we were at war with two or three first-class Powers, the people of this great country would rather see this Empire broken up to pieces and the country overrun than they would submit to some form of compulsory service. I do not think, if they really understood the danger, that they would do so; but I believe that before you get the people of this country to submit to compulsory service you will require a disaster, and not a disaster at a distance, which does not affect them much, and which they do not care very much about, but a disaster at home. In that day, I think, very likely people would agree to compulsory service, though it might be too late. With regard to the tax on labour, no doubt conscription interferes with labour. At the same time, in these days, what are we doing? We are importing paupers and we are exporting able-bodied men. There was a debate in the House of Commons on this subject, which, I think, went rather wide of the question. The result is that these pauper immigrants are squeezing out our able-bodiad population in favour of them. Pauper Jews who come here do our work cheap. If cheapness is what we are only looking for, that may commend itself to some people, but I for one do not support such a view; on the other hand, none of these Jews join the army. They may perhaps be naturalized, but I do not suppose there is 1 in 1,000 of them who would help us in any way in time of war. Therefore, I think they had far better be kept out. With regard to the colonies, no doubt if we were in a great difficulty the colonies would come to our help, if they were still part of the Empire. It may be that they will have left us; that depends upon the people of this country. Therefore, on the whole, I am of opinion that the time is not yet ripe for compulsory service, and that we should first increase the inducements for men to enlist; at the same time I admit that if we had conscription it would be a very great advantage to the people of this country. If such were the case, then many men who now know nothing whatever about our colonies, who have no idea what the British Empire is, or the extent and glory of it, would go abroad to all parts of the world and would return home with so exalted an idea of what the Empire is, that they themselves would be willing to defend it, and would do their utmost, by their votes and other means, to induce others to take the same view, which is much wanted. I think that in that way compulsory service would be a very great advantage, not to mention other reasons.

Major RICKARDS (1st London Volunteer Rifle Brigade): I feel very much diffidence in speaking before so many distinguished military men of the Regular army, but, as a Volunteer, my excuse must be that I am first a citizen and secondly a soldier, that is to say, I have attempted to make myself a soldier. I have taken a great interest in this question for a great number of years, and as an apology to this meeting for addressing it, I may mention that I have been for over 20 years a Volunteer, and have twice attended the German army manœuvres, and I have looked at this question both from a citizen's point of view, and, as far as I am able, from a soldier's point of view. A great deal of what I intended to say has been already said by General Dashwood, but it strikes me first of all that we have got to make the assumption, before it is worth while dealing with the question at all in detail, that the people of this country have at the present moment the fact brought home to them in the slightest degree that there is any necessity for conscription. That there would be a necessity for conscription if we were called upon to fight a big Continental Power, and to operate by land, I personally have no doubt whatever, provided, that is, they once get over what General Tyrrell referred to by the well-known name of the "silver streak." Of course we could not then meet in any way the numbers that could be brought against us, but I do not think it is at the present time brought home to the people of this country that there is any necessity for universal conscription, and I do not think anything short of a disaster, such as befell France in 1870, in their great national defeat, would bring it about. Then it remains for us as practical men to see what we can best do under the circumstances, whether we are to prefer the present system of a small highly-trained army, supplemented by partially-trained auxiliaries, to a more universal system of compulsory service in some shape, and a less highly-trained Regular army, which would, in my opinion, ensue from any system of compulsory service likely to be accepted by the country at the present

time. I do not know whether I make myself clear. At the present time, we have a very highly-trained Regular army, supplemented by Militia—of course I put the Reserves into the army for fighting purposes—and by Volunteers, and also by Indian and Colonial Volunteers. We have, I think, to compare the advantages or disadvantages of that system with that of possibly having with a less highly-trained Regular army, as we now understand the term, a more universal form of conscription; because I do not believe that anything but a great national disaster would make the people of this country accept a rigorous compulsory service. I mean to say, that assuming you can force the nation at this moment, although really you cannot force the nation in these voting days, but if you can induce the nation to accept compulsory service at the present time, it would be compulsory service of a very mild order, it would not be thorough; and the question therefore is, which are we as practical men to prefer—the present system of a small highly-trained army with Reserves, supplemented by auxiliaries, or a less highly-trained but larger army, with a system of what I may call mild universal conscription, not as rigorous as that carried out in Germany and on the Continent? That is a purely military problem which distinguished soldiers in this room are far more capable of dealing with than I am; but, speaking first as a citizen and secondly as a student of history to a certain extent, I say that you will not get the English people to accept compulsory service, and, therefore, you must choose between the two. The practical effect of my suggestions is that it is for the nation to decide whether they will have compulsory service, to which I say the answer is pretty clear, that they will not have it at the present time; and if you do not have universal military service, it is for military men to decide whether they will accept the present system of a small highly-trained army, supplemented by partially-trained auxiliaries, or accept as an alternative a larger army with something like a system of universal compulsory service, which would necessarily by the nature of the circumstances and the state of public opinion of this country be of a milder and less efficient order than the system of universal conscription as practised on the Continent, and would result in a less efficient, although more numerous, army than the small army which we at present possess.

Lieutenant-Colonel C. S. Graham, R.A.: I must plead as an excuse for speaking on this occasion that this is a question that has always interested me through my military career. In addition to that I have had five years' very intimate experience of the Militia and five years' of the Volunteers. Our lecturer has taken us in a very pleasant manner down the stately avenue of military history, and, that being so, I want to make one or two comments on the paper generally. First of all, I think we may take an example from Rome, and recognise that the defence of one's country is certainly a duty, but also a privilege. Coming to the case of Carthage, which the lecturer has told us was the first to employ mercenaries on a large scale, and which he says shows a curious analogy to our own Empire, I may say that I in like manner consider that Great Britain is not alone a mere nation, but is also an Empire with Imperial responsibilities and duties, and that on the day when she feels that she cannot maintain that Empire without the aid of mercenaries she will cease to be. I would further remark on the lecturer's reference to Fortune, that if Fortune is fascinating she is also fickle, and I would say with the song, "Trust her not." The lecturer says with regard to the question of conscription, "Its advocates affirm that the system inculcates national habits." I may add for my part that I think what are termed the military virtues are valuable to any man, whether civilian or soldier. They are valuable to him in after life. Any of us who have had experience of military training will agree, I am quite certain, that when we go back and take up any calling or business in civil life, we shall find it all the better for us if, whatever our other qualities may be, we can carry our military qualities into the occupation we take up, whether we may have been officers or non-commissioned officers. It is a great happiness to me to know that there are many non-commissioned officers holding positions in civil life whose military qualities have been found to have a certain specific value to the nation at large. As to the difficulty of conscription, we have to meet the fact that conscription is contrary to the instincts of the British nation. We are sometimes told that we are not a military people. Now I believe that we are a military people, but there is this distinction between ourselves

and the Germans, viz., that the German nation is pervaded by militarism and we are not. Coming to the question of conscription, can we in any modified form strengthen our military resources without adding considerably to taxation? The ballot is only suspended for the Militia, and it does seem reasonable that every district should be required to supply its quota of Militiamen. I will not go into details as to who should be exempted, but certainly the efficient Volunteer. The principle I advocate does not seem unduly exacting. It seems also to me that the youth of this country might be required between the ages of 18 and 25, in some form or other, to show that they have had an elementary training. The young man can do that easily as a Volunteer, and, if not as a Volunteer, then as a Militiaman, and if not as a Militiaman, then in the Regular army. The Volunteer system is one which we value very much, and we know what service men have given and do give to it. There are numbers of men I have known who have given freely and readily not a grudging 10 or 12 attendances, seeking only to fulfil the minimum requirement, but they have willingly and generously given from 70 to 100 attendances in the year. It seems to me that, with that Volunteer system in existence throughout the country, it is reasonable that we should demand that the youth of this country should qualify at least in elementary military knowledge, because on an emergency if a man has an elementary military knowledge it can very quickly be added to. In my own case, I was drilled at school by an old Waterloo sergeant when I was 12 years old, and I must say that I found this school training a very valuable help when I became a Woolwich cadet. I consider that in every grammar and public school of this country—happily many of them have cadet Volunteer corps in which training may be carried a little further—yes, throughout the whole of the schools, some portion of the time given to football and cricket, &c., might be devoted to elementary military training, and all the boys should at least be rendered familiar with squad and company drill. A few years ago, at a time when I was serving as an Adjutant of Militia, I was staying at Lucerne, seeking information beyond my own regiment and country. I talked with Swiss officers of different services, for I aimed at taking a large and comprehensive view of this question, because I look upon our military provision as a national question. I there saw a number of men drilling in plain clothes. The Swiss officers were most courteous and polite, and always ready to answer any question that I put to them. I saw, I say, a certain number of men drilling in plain clothes. They (the officers) asked me, "How long do you think those men have been out?" "Well," I said, "perhaps a fortnight or three weeks." The reply was, "They came out yesterday." The fact was that those men had been trained as boys at schools where drill on military lines was carried out not merely as a form of the physical training, but as a drill that would be very valuable to them when called upon to assume their military rôle. Unfortunately a great deal of drill is now being taught in schools not on the lines of military drill. I am on the committee of one or two schools, and I always insist as far as possible that the drill taught the boys shall be the drill of the Red Book in force for the time being, as regards squads, companies, &c. It seems to me that if we can get such a system introduced into our public and grammar schools the boys may be efficiently trained, and they will never forget the training that they have thus received. Not only will it cultivate a military bearing and instinct, but physically I am sure they will gain by it. If you develop this system with regard to the Volunteers, and insist that men between certain ages must give a certain sort of military service, and that the army Reserves shall get their drill with the Volunteer forces in the places where they reside; if that system of drill is generally adopted throughout the country, there will be more employment found for worthy non-commissioned officers, creating another provision for, and consequent attraction to, men to join the army, seeing that there are some rewards for them afterwards, and this will be found to have a good effect upon recruiting generally. You see, I hope, the idea that I have in my mind, and in bringing it forward I speak from definite knowledge, because I have had the experience of an adjutant in my own regiment, the Royal Artillery, and also in the Militia Artillery and the Volunteer Artillery.

Sir JOHN COLOMB: I quite agree with the last speaker as to the utility of boys in the schools of this country being taught the rudiments of military drill. I

think such a system possesses a number of advantages, but that is not the particular question before us. I think, also, that any expense of training given in schools, such as that suggested by the last speaker, should certainly be charged to the Education vote, and not come off the Service votes, which are small enough. I would like to ask the lecturer a question. I cannot exactly make out whether he means that 200,000 more men would be under arms in the United Kingdom every year than there are now, for I observe he speaks of 200,000 men being taken every year off the labour market of this country. Does he propose an addition of 200,000 to the actual number of men under arms in the United Kingdom? I would also ask him why, in his very excellent historical view of the question, and having brought that historical view down to the present time, he has altogether omitted Canada? He has mentioned the Channel Islands, and, if I remember right—I speak under correction—compulsory service in the Channel Islands is purely and simply for local purposes—for the defence of the Channel Islands, and for nothing else. But the Dominion of Canada is the only portion of territory under our flag where compulsory military service is the law and where there is no territorial restriction with regard to where service can be applied. You have in this country legally the power of exacting compulsory service for the Militia. I disagree altogether with the idea that because it is not used it has ceased to be a legal power, and would not be applied in case of necessity. But there, again, service in the Militia is restricted within the limits of the United Kingdom, except by voluntary agreement. In Canada service is not limited to Canada. I would really suggest to the lecturer that, in view of what the first speaker said with regard to the colonies, it would be well, before this historical review goes into the Journal, that Canada should not be wholly omitted, for the reasons I have stated. Now, coming to the main question before the meeting, does the lecturer mean or propose to apply compulsory service to the population of the United Kingdom without limit to the territorial application of forces so raised? Is it to be understood that the proposal is that compulsory service is to be in effect an obligation to serve in another part of the world? If that is so, then it is an entirely novel feature as far as the present state of things or history goes, because compulsory service has always been mainly and in effect compulsory service for defending the territory in which the force is raised.

General DASHWOOD: Compulsory service is not in force in Canada, I think, although it is the law.

Sir JOHN COLOMB: I am not discussing the question of enforcement of compulsory service, I am discussing things as they exist with regard to the legal liability. That is a point it is material to bear in mind. When the advocates of compulsory service speak in its favour, and in support of persuading the people to adopt it, are they perfectly clear in their own minds what they mean? Do they mean that we are to have compulsory service rendering men liable to serve anywhere wherever they may be wanted? You cannot run away from that question. If you say, "No, we do not mean that, we mean compulsory service for the defence of these islands, the United Kingdom," then I am altogether at issue. I say it is not wanted; I say the defence of this part of the Empire, this citadel of the Empire, does not depend upon your military strength, it depends upon your naval power. To pass away from that, I would observe that before we advocate tremendous constitutional changes in our military system, such as compulsory service involves, are we quite sure that we are doing the best with the material and means we have at our disposal? I quite agree with the lecturer as to our enormous military responsibility over sea growing and not resting. We have two land frontiers—the frontier of Canada, the frontier of India. If you put those two frontiers together they are in extent equivalent to the distance from England to Cape Horn. I admit that our means are insufficient, I admit the great growth of our military responsibility over sea, and I am bound to admit the apathy with which the public regard such military responsibility, and I ask have we got a settled military policy at all? Before we go to the country, or before you can persuade any considerable section of this country to contemplate for one moment the application, even in a modified form, of compulsory service, I ask you to be quite clear that you can go and plainly put before the people that there is nothing

else to be done. I think there is this to be done. I think for the last generation we have been developing a military policy without the slightest idea of the main principles upon which our military policy must rest. Taking the total military strength of the Empire, as stated in the paper, at 700,000, if you, as I think you are bound to do, acknowledge that the safety of these islands is mainly a naval question, and not a military one, then I ask what business have we with 500,000 men only available for the defence of the United Kingdom, leaving only 200,000 men for requirements abroad? I say that, in my judgment, the time has not come for considering compulsory service. It is far off; I believe it never will come. And, before I sit down, I must disagree with the lecturer when he says that if we were engaged in a war with any great Continental Power "within six months we should be brought to a standstill for want of men." I would ask him to apply that. Supposing circumstances caused a war between Germany and England, does he mean to say that there would be a necessity for a single British soldier in Germany? Supposing you had war with Italy, does anybody mean to tell me that you could contemplate for one moment the necessity for a single British soldier in Italy? Your wars would be naval wars. But when you come to the United States or Russia the aspect of the question changes altogether. The whole military policy of this country, I think, must be based upon reliance on your fleet, with regard to your safety at home, and upon the development of your military striking power abroad, advanced under cover of your fleet. I would ask this, supposing you are at war with Russia. There comes the military strain at once. Are you preparing for that strain by the greater portion of your men being tied to the United Kingdom when you know they may be most wanted on the Afghan frontier? Taking the case of the United States, is it satisfactory to know that you have 500,000 men in England that you cannot move, though you may want them in Canada? Therefore, I say that your military policy is not founded upon the necessities of the case. I think the difficulties in the House of Commons, and in the country, have greatly arisen from the confusion—I say it with all deference and respect—in the minds of the people and of the House of Commons as to what the principles of British defence are and must be. Before we propose changes or expect national changes to be accepted by this country we must be agreed among ourselves as to what are the principles of our policy, and be able to explain that policy to the country, the reason of it, and the necessity for following it, and then the country will give you what you want, and it will not give it you before.

Colonel CAVE: It is with great diffidence that I attempt to speak after the very able discourses that we have listened to, but as an employer of labour and a Commanding Officer of Volunteers, I will venture to make a few observations. I cannot help regretting that in almost every discussion with regard to the military efficiency of the country in this lecture hall, there seems to be a fatality very much like that which impelled Mr. Dick to introduce the head of King Charles. Sir John Colomb has introduced our King Charles' head on this occasion. We always get to a deadlock with reference to the military efficiency of the defensive forces, as someone insists that the navy can do everything, and consequently there is no occasion for military efficiency.

Sir JOHN COLOMB: Oh no.

Colonel CAVE: I certainly understood Sir John to say not only in the defence of these islands, but even in attacking almost any European Power, it is still a naval question, and I fully expect to hear that if we are at war with Switzerland, it will be a naval question. To come back to what we are really talking about, namely, whether compulsory service is desirable and possible in this country, the reason why it is thought to be quite impossible, I submit, is, because our men of light and leading always declare it so to be. We are constantly told by the politicians that all things are perfectly in order now. Well, I do not think so, and I do not believe any military men think so. I am certainly not here to say anything detrimental to the force to which I have the honour myself to belong; I am exceedingly proud of that force. I think that what we are able to do, and the amount of efficiency we are able to arrive at, is really wonderful, considering the conditions of the Service, but the conditions of the Service are not such as to enable Volunteers to achieve that efficiency which we should like. It is a very trying matter to a Com-

manding Officer of Volunteers that the conditions of the Service are such that, whatever may be ordered, nobody need obey, and it frequently happens to a Volunteer officer that, when he orders a parade, he hopes to get it may be a company, it may be a battalion; he goes to the place of assembly, and instead of a company there is a section, and instead of a battalion there is a company. Now it cannot possibly be that that is a condition of things likely to bring forth the real efficiency which we all desire, and, I suppose, whenever a Commanding Officer of Volunteers hears anybody talking about compulsory service it, more or less, makes his mouth water. Looking at it from the employer of labour's point of view, I think that the two sentences towards the end of the paper really contain the whole gist of the matter. The lecturer says: "The advocates of compulsory service affirm that the system inculcates national habits of order, punctuality, endurance, and subordination." Can there be any shadow of doubt that that really is the case? I do not think any reasonable man can for a moment doubt that it is so. As for the opponents, who think that the life and training of a soldier engender bad habits, I am convinced that the habits of drunkenness and such other detrimental characteristics are far more likely to be brought about by idleness than by military training. The fact of withdrawing a few hundred thousands from the overstocked labour market would most certainly have an exceedingly beneficial effect. I know it is the habit of our great leading men, especially in the political world, to thank God that we have not compulsory service. I think they make a very great mistake, and if we could persuade our leaders to take a right view, and so instruct the masses, a right opinion would soon prevail; the people, we know, are quite ready to follow those who are blessed with the gift of eloquence. They will follow them in directions which are nothing like so wise as would be the adoption of compulsory service. If the gallant gentlemen of the navy wish, let them have compulsory naval service also, if only they will promise not to bring King Charles' head into these discussions any more.

Colonel C. A. MUNRO: Previous speakers have said so much on this subject, that I really now have very little to say. I think General Tyrrell may be congratulated, not only on the very excellent lecture he has given us, but on his courage in touching such a very unpopular question as compulsory military service. It has always been very unpopular with the majority of our countrymen, at all events the civilian portion of them. Why it has been so I have been trying all my life to discover, but have never come yet to a satisfactory conclusion. The chief arguments I have heard against compulsory service are, that to take young men at the age of twenty, at the time when they are most fitted to learn a profession, a trade, or a business, and to compel them to serve in the army, would be detrimental to the commerce, trade, and business of this nation. If it were proposed to compel *every* young man of twenty so to serve, of course there would be great force in the objection, and it would be unanswerable. But although they would all be liable to serve, it is not intended that every young man should be drawn. We have a very large population, and at the utmost we should require a force of 200,000 men out of a population of 38 millions. Could it possibly deteriorate the trade and business of the nation if such a small quota from our teeming millions were compulsorily drafted into the army? General Tyrrell has stated that there are indications quite the other way. We are suffering from a redundancy of unemployed men. There are a greater number of men unemployed than would fill up your army to 200,000 men, but unemployed men cannot be reached, for, except by compulsory service, they will not enter the army, because the stern punishments of military discipline would prevent them going on strike, and then the chief recreation of their life would be denied them. Not only that, but we have a great number of able-bodied men in London and other large towns employed in entirely women's work. What detriment to business would it be to take those men from their effeminate employment, and draft them into the army? I allude to drapers' assistants. General Tyrrell said he confessed to a feeling that the pressgang of former days was not an unmixed evil, when he saw a lot of corner men loafing about at public-houses. I share the same feeling whenever I go into a drapers' shop, and when I see those able-bodied men dribbling out yards of ribbon, cutting off yards of calico, and asking their lady customers what is the next womanly office they can do

for them. I do, in such cases, feel real regret that the pressgang is not in existence. One of the speakers has said that we must depend entirely upon our navy and our insular position for the defence of our coast, but I do not think we can altogether do that; we must have a small home army and we have not got that at the present time. Our home army consists of small training depôts for the regiments abroad; if we had universal compulsory service that would be remedied.

Vice-Admiral P. H. Colomb: We have been, in a friendly way, accused of bringing King Charles' head into this discussion; so I use a few words to take King Charles' head a little out of it. I think sentimentally, and from the point of view expressed by the last speaker, and by Colonel Cave, that the navy would be decidedly in favour of compulsory service. It might take Colonel Cave's further view of it, and say, "Let us have it both by land and by sea." But then that would only be our sentimental view of it, as we should simply say that training and discipline in the service of the Crown always leave a man better than they found him. I do not think any of us have ever gone so far as to consider what would come to us in the event of our establishing compulsory service in these islands—as to the cost of it, as to the provision of officers to train a compulsory service army, which, I presume, must be a very large one. But where we do see difficulties in compulsory service has, I think, been expressed by Sir John Colomb fully, but at the same time in a way that, it seems to me, might very easily be misunderstood by those who had not, like him, been for years looking at the question of what the duties of the navy are, and what the duties of the army are, together, in the protection of this country. He said—and I think every naval officer will agree with him—that the real reasons for a great army or for great armies are found in the Canadian frontier and the Indian frontier, and, I think, he has expressed our general view that when this question of military forces is discussed, military officers never seem to dwell sufficiently upon those two frontiers. They touch upon them, and the lecturer has spoken more fully, perhaps, on the Indian frontier than is usual; but in our view they are not considered so fully as they should be. I think Sir John Colomb meant this: that if you brought that particular question fully and continually before the country, you might get at length an army which would be efficient for the defence of these frontiers. But you put yourselves often, as it seems to us—we may be wrong—in a difficulty when you say that the necessity for compulsory service in the army arises from the fact that compulsory service exists on the Continent, and that European nations have standing armies of enormous size. Those of us who have studied the question most closely are quite agreed that, by reason of steam cutting both ways, there are no greater facilities in the present day for invading these islands than there were in the days of sailing ships. I am quite open to conviction the other way, but those of us who have most examined the question are most clearly of that opinion. They think, indeed, that the power of steam against invasion is greater, I might almost say, very much greater, than the power that steam has given to invasion. Therefore, I think, it is not a wise policy for those who desire to see a very much larger army than now exists, to base their argument on the state of things which those who have most closely examined the matter say is not a fact. That, I think, is the point which Sir John Colomb has brought out. We do not say, and we never have said, that a considerable army is not necessary in this country. You must have considerable armies, and you must have garrisons of certain size in all your exposed points of territory which may have to be defended against an enemy coming over sea. You cannot get away from that necessity, but you must not suppose that you are going to have an attack over sea by enormous forces, because the difficulty of getting enormous forces over has not decreased in modern times. The lecturer mentions, in the usual way, the case which, if it does not come in as King Charles' head, comes in as his beard and his moustache. He falls into the common error of assuming that there was a British fleet in the Mediterranean when Napoleon proceeded to invade Egypt. Now, if there had been a fleet cruising about in the Mediterranean when Napoleon started, if Napoleon had known that there was such a thing, history rather tells us that he would not have started. As a fact, when he did start, there was no fleet in the Mediterranean. The French and Spaniards together had driven the fleet out of the Mediterranean, and it was because they

were driven out of the Mediterranean that Napoleon conceived the idea and carried out the idea of invading Egypt. I have said pretty nearly all I have to say, but I want to clear the minds of military men. We do not say that we can absolutely exist without military forces: they must always be a part of the defence. All that we do say is, that when you take the naval defence into consideration you will see that your numbers of military forces may be limited so far as attacks over sea are concerned; but not so far as attacks upon the Canadian frontier and upon the Indian frontier are concerned. I wish to ask the lecturer to clear one point, or perhaps General Dashwood would do it himself, which I do not think ought to go forward uncleared up. In England we have, at the present moment, a Reserve of some 80,000 men, who have served seven years or thereabouts with the colours, and General Dashwood spoke of the necessity of keeping them longer in the Reserve. I have understood that the reason why service in the Reserve is kept short, is that difficulties stand in the way of frequent training, and that, therefore, men longer in the Reserve would be too rusty for efficiency. It would be interesting to record whether that is so or not.

General DASHWOOD: I consider that a man who has been a soldier for 10 or 12 years would not be so rusty even after 21 years, but that he would very soon be as effective as regards discipline and knowledge of his arms as ever he was before.

Lord WEMYSS: It was only an hour or two ago that I heard of this lecture being given here to-day, and as it is a subject in which I have always taken the very deepest interest, this question of compulsory service, I ventured to come and hear what the lecturer had to say. What I feel, and what everyone must feel, is, that we are greatly obliged to Major-General Tyrrell for the excellent *résumé* and historical account that he has given us of the different systems of military service. If I am not mistaken he began with the patriarch Abraham as the first great organizer of armies. He passed down from Abraham to the Greeks, the Spartans, the Romans; he then got down to Charles VII of France, to Cromwell, and he ended with Moltke. The burden of the gallant general's song is "compulsory service." I am very glad that he has not used the word "conscription," because, unfortunately, very often "compulsory service" and "conscription" are used as synonymous terms. I venture to think they differ, and that you might have in this country compulsory service in a certain sense without having anything approaching the system of conscription which prevails abroad, and which the gallant general of marines, Sir John Colomb, deprecates so strongly. It would be, perhaps, too much to say that because a general of marines is strongly in favour of the navy, and believes the navy is all-sufficient, he is simply saying "There is nothing like leather," but certainly the tone of Sir John Colomb's speech was that you should trust your navy alone, if you were at war with Germany, France, or Italy. Possibly he said you might have to defend a frontier in India, possibly in Canada, but he did not say how you were to do that, or whether you had sufficient armies for it, his contention being that in the main you must trust to your navy.

Sir JOHN COLOMB: Will you allow me to qualify that? I did not intend to convey that impression. I speak of relying upon your navy for the defence of these islands, and only these islands.

Lord WEMYSS: If the navy is sufficient alone and unaided for the defence of these islands——

Admiral COLOMB: No!

Lord WEMYSS: The gallant admiral shakes his head. There is here, I see, a little family difference. I gathered from the speech of the gallant Sir John Colomb that he thought the navy was sufficient; the gallant admiral thinks it is not; but what I was going to say, speaking as a civilian, is that it is not sufficient, because there is a possibility of its being proved not to be so. If it is sufficient, what is the use of our spending large sums on the Militia? What is the use of our spending large sums on the Volunteer force? Why do they exist? Simply because, in the opinion of the majority of sensible men, you dare not trust the safety of this country simply to your first line of defence, which is the navy. That is the whole question. The admiral again shakes his head. A minute or two ago he said you were not to trust the navy; does he now mean to say that

you can trust the navy, and that there is no necessity for the Militia and Volunteers?

Admiral COLOMB: I said, and I understood Sir John Colomb to say so also, that there is a necessity, but what we say is you must not exaggerate that necessity.

Lord WEMYSS: But if you have a necessity you must assume the possibility of the fleet being drawn away—we will not say defeated—and that somehow the enemy may land.

Admiral COLOMB: No.

Lord WEMYSS: I had better state what I feel myself. What I feel very strongly, and what I believe most men think, and what I believe every Government and every Parliament has thought, is that it is necessary, in case the fleet, your first line of defence, should prove insufficient, to have a second line of defence for your hearths and homes, and therefore that this country should have for this purpose the Militia, the army, and the Volunteers. But what is not I think sufficiently pressed in this able paper by the gallant general is that all that is necessary to make that second line of defence everything it ought to be, in case it should ever be required, is no new law, but simply the application of our existing military system. And what is that? It is an army voluntarily enlisted for foreign service; and I go heartily with Sir John Colomb in thinking that you could not by possibility enforce conscription or compulsory service in this country and take men from it forcibly to serve in India, in your colonies, or anywhere else. In the case of Germany and France, their colonies are mere trifles, it does not affect them, but in England it is different. Our military system accepts that position, and we have thus, in the first place, voluntary enlistment for the army to serve at home, to serve in Ireland—as yet—and to serve abroad anywhere and everywhere. Then you have, for home defence, the Militia, with power on the part of the Militia to volunteer for service in the army, and what does the law say about the Militia? How should the Militia be raised by the law of the land at this moment? By compulsion. That is at the present moment the law of the land. It is not called "compulsion," it is not called "conscription," it is called by the good old English name of "ballot," "ballot for the Militia," and that is the standing law which has existed from the time of the great war, ever since there was a Militia, to the present day. It is simply annually suspended, as Sir John Colomb knows, by a "Militia Annual Suspension Bill," and if it were not for that you would have every man liable to service in the Militia. Nay, more than this, Governments are so well aware of the value of this system of compulsory service for home service that when Lord Cardwell, in 1870, brought in his Bill for the reform of the army by means of short service, which was founded on the German system—with, however, the part of Hamlet, or "conscription," left out, which made all the difference—it was the play of Hamlet without Hamlet—part of his Bill was to reorganize the ballot districts. If you wished to enforce the ballot now it would probably take six months before you could get a man to serve in the Militia, and he proposed to reorganize the districts so that in a fortnight or a month you could get men forcibly, and therefore the idea of compulsion was then at the bottom of the whole scheme of military reform. I believe the Bill was worthless without the question of the ballot. Lord Sandhurst, then commanding in Ireland, was brought over to consult with Lord Cardwell, and I had a talk with him about this ballot question before Parliament met. He said that he had still great hopes of inducing the Government to agree to compulsory service for the Militia. He said it was all that was wanted. It was simply asking Englishmen in return for the privileges they enjoyed to run the risk of military service in some form or other at home, and only at home. The exemption from Militia service is service in the Volunteers; that is the law; thus, if not serving as a Volunteer, a man would be liable to be balloted for the Militia. Patriotism had no doubt a great deal to do with it, but what was the history of the 400,000 Volunteers in 1803 when Napoleon threatened invasion? The ballot was in force for the Militia, and to avoid being balloted for they served in the Volunteers. That is what you want to bring about now. But at that time you could get exemption from the ballot; we should simply allow no exemption of any sort or kind from service in the Militia, except service in the Volunteer force. What would that do? It is

not for me to say whether the Volunteer force now is or is not efficient; I believe it is wonderfully efficient, all things considered, and nothing ever astonished me so much as to find, when I had to do with it, that men would continuously come from their business at late hours of the night to drill in Westminster Hall simply from public spirit and for the defence of their country. But you must not ride a winning horse too hard; you cannot enforce on a man whose period of service is limited to 14 days' notice all the conditions necessary to get thorough efficiency, and to make a thoroughly efficient military force. But if the Volunteers were in this position that they were liable—if they did not fulfil all the conditions laid down by the military authorities as necessary for thorough efficiency—next year to be balloted for the Militia, you would have the force thoroughly efficient; as efficient as such a military force need be. I am very grateful to the gallant general for this very able paper, but I wish he had dwelt a little less on what foreign nations had done and a little more on our own existing Service law. And now why have we not the ballot in force? It would keep your army and Militia full; it would keep your Volunteers efficient. Nay, more, you could say, "You shall not only be efficient, but you shall pay for your own efficiency; we withdraw the grant." Why is it that we have not got it? There is not a Secretary of State for War, there is not a Commander-in-Chief who has ever been at the Horse Guards, who would not give his eyes to have the ballot in force for the Militia. But he dared not, and why? The Commander-in-Chief can merely advise; he is not omnipotent. The Secretary of State for War cannot enforce it; because they know that such is the state of patriotism and public spirit in these days that if the Conservative Party or the Liberal Unionists were to bring in the ballot for the Militia, the other side would immediately stump the country against it. That is what would happen, and what the people of this country have to work for is to try and get this question of national defence put upon the same basis and footing as your foreign policy. Your foreign policy, happily as you see, through Lord Rosebery, is firm and true to what is believed to be right and national. It is not made a party question. It has been taken out, and I hope it always will be taken out, of the battlefield of party. You ought to do the same thing on this question of compulsory service. It is even more necessary, for the safety of your hearths and homes, and your liberties virtually depend upon it. The question of home defence should also be taken out of the battlefield and domain of party politics, and until that is done all these discussions here upon foreign military systems or our own are absolutely worthless, and are so much waste paper. Let Sir John and let the admiral go about and stump the country in favour of compulsory Militia service. I tell you what my experience has been. I have never yet spoken to my constituents, when I had them, or anywhere else in the sense in which I have been speaking here, without meeting a ready and hearty response, and I have never had the fact disputed that an Englishman or Scotchman, or whatever he might be, was bound to serve in some form or other for home defence. I have advocated this principle everywhere, and never yet have I met with any unpopularity for doing it. I would strongly recommend any political man in the House of Commons to take the same line, and I believe he will find it answer extremely well.

Major-General F. H. TYRRELL: Will you allow me to answer some of the questions put to me? General Dashwood objected to my proposal with regard to the Militia. You will of course understand that I have really made no detailed proposals at all, because I only put them forward in a very tentative kind of way. My only object in giving the lecture was to draw attention to the desirability of having compulsory service in England, and if people make up their mind that it is to be seriously thought about the details can be thought out afterwards. But what I did put forward in the paper was the two proposals: one that the Militia should be composed entirely of men who had passed through the ranks of the Regular army; and the other proposal was that the Militia should be like the present Volunteer force, in fact it was making service in the Volunteers compulsory. That sounds rather Irish, but you must excuse me, because I am an Irishman. I quite agree with General Dashwood's remark about our Reserve system. As we are on the subject of Ireland, there is a story about an Irishman

who wanted to lengthen his blanket, and so he cut a piece off at the top and sewed it on to the bottom. That exactly describes the present Reserve system; we turn a lot of men out of the army and enlist in their place a number of lads who are really not fit for the fatigues of a soldier's duty. Major Rickards said we should never get this question of compulsory service considered in England till we had a good lesson, and I believe that myself. I believe nothing but a jolly good licking will ever drive the idea into John Bull's head. It must come at last. As regards Colonel Graham's remarks on the advantage of military schooling and training up the young idea in the way it should shoot, I must say I myself am quite of the same opinion as Swift's Irish captain of horse, who said—

"To give a young fellow the right education
The army's the only good school in the nation."

Sir John Colomb wanted to know how 200,000 recruits would be wanted every year.

Sir JOHN COLOMB: I only asked if you proposed that 200,000 armed men should be added to the establishment.

Major-General TYRRELL: I proposed that 200,000 recruits should be added to the army every year, who would of course only replace 200,000 others who would pass into the Reserve; that is in case we adopted the Continental system entirely, having universal compulsory service. I suppose the present population of the United Kingdom on that system would yield, in round numbers, 200,000 recruits per annum, young men who had attained the age of 20 years after all exemptions were considered; they would join the ranks, and 200,000 men who had completed their three years' service would pass into the Militia. Canada I did not introduce into the lecture because I was not quite certain whether the Militia service in Canada was compulsory or not. General Dashwood says it is legally compulsory but it is not enforced.

General DASHWOOD: They get as many Volunteers as they want.

General TYRRELL: It is on the same footing as in England.

Sir JOHN COLOMB: They do not suspend it annually, but it is simply in abeyance. It is the law.

General TYRRELL: They get as many Volunteers as they want. I agree with Sir John Colomb's remarks on English military policy, because really I think that policy consists in spoiling the ship for a ha'porth of tar. I have heard of a Chinaman who burnt down his house when he wanted to get roast pork, and I have also heard of a War Office, nearer home, which broke up horse artillery batteries when it wanted to make a wagon train. Colonel Munro spoke of the hardship of making every young man of 20 years of age go in for military service. I will tell you an anecdote. I am afraid you found my lecture rather dull and an anecdote may relieve its dulness. Yesterday I was coming up in the train to town and I saw a young man sitting in the same carriage with me. We got into conversation. I thought he was a German. He said "Yes." "Have you served?" "Yes, I served my one year." I said, "What is your opinion of compulsory military service? How did it affect you?" He said, "It spoilt my career. I had a good opening in life at the time I was taken for a soldier. I could not get off, and it has altered the whole course of my life. It has also prevented my spending an extra year at the University, so that it has crippled my education. In spite of that," he said, "I think it is a good thing on the whole for the country. I think it was a necessity for my country, and," he said, "I should not be at all surprised if you saw it in England some day too, because," he said, "I believe, myself, in the possibility of the invasion of England." That is of course a matter of opinion. Of course we trust to our navy to prevent us keeping up such a large army as a Continental Power, and suffering what we believe to be the hardships of compulsory service. Admiral Colomb referred to my mention of the invasion of Egypt by Napoleon, when a French fleet landed an army on the shores of Egypt. I am open to correction, but I believe there was an English fleet in the Mediterranean at that time when Napoleon was actually on the way from Toulon to Alexandria, and it was commanded by Nelson.

Admiral COLOMB: When the arrangement was contemplated the fleet was not in the Mediterranean, and was not expected to be in the Mediterranean, and its absence was the cause of this invasion.

General TYRRELL: As a matter of fact the English fleet actually called at Alexandria a week before the French landed there.

Admiral COLOMB: The day before.

General TYRRELL: Lord Wemyss told us the 400,000 Volunteers who enrolled themselves to repel Napoleon were greatly influenced by the desire to escape the ballot for the Militia which would then have been put in force. We all know that in those days the recruiting sergeant's usual appeal to a young man to enlist was that he had better join the army in order to escape being scratched off the church doors into the Militia. I myself am entirely in favour of applying compulsory universal service in the United Kingdom with the utmost rigour, but I am quite conscious that I am not an unbiassed or impartial advocate. I am so fond of soldiering myself, and so thoroughly believe in it, that I should like to see every one of my countrymen a soldier. I quite agree with the sentiment of the old poet of the Cavalier times who said—

> "A steed, a steed, of matchless speed,
> A sword of metal keen;
> All else to noble minds is dross,
> All else on earth is mean."

Of course other people look at it from a different point of view, and my only object in giving this lecture is to draw the attention as far as possible of those interested in the matter to it, and to try and bring it before the public, because it is only by constantly discussing it that we can hope to achieve the result and to dissipate the prejudices possessed by English people against it.

The CHAIRMAN (Sir Harry Prendergast): I think we are all much indebted to General Tyrrell for his admirable lecture, and we have listened with great attention and profit to the speeches of those who have taken part in the discussion. Some years ago, in 1875, there was a discussion upon a somewhat similar subject. A Prize Essay was written by Captain Hime, of the Artillery, on "Universal Conscription the only answer to the Recruiting Question." There was a very long discussion, which took several days. The general principle he advocated was Universal Conscription, and to let all able-bodied men serve for one year. Then followed Generals Sir Edmund Warde, R.A., and Sir Lintorn Simmons, R.E., both of whom deprecated the system of general conscription, and General Sir Lintorn Simmons proved generally that we were wrong in taking our recruits so young, and that it was much better to pay for only able-bodied men. Lord Waveney followed, and proposed to employ the Militia brigades as nurseries for the Regular army, to keep them on foot two years, to take their turn with the Regulars. Mr. Holmes would have a short service system for home service, and long engagements for India and the colonies. Colonel the Hon. F. Thesiger, now Lord Chelmsford, would fuse the Militia with the Line, and he advocated long service. Colonel Ponsonby Cox proposed enlistment for nine years—three with the Colours and six with the Reserves, and one shilling a day pay for Reserve soldiers. Colonel Leahy added that every man of 50 years of age should be pensioned. Then followed General Sir John Adye, who took an optimist view, concluding his remarks by saying the country is better prepared for war than at any previous period within his recollection. Colonel Lumley Graham proposed conscription for the Militia, which would feed the army. We should enlist for 10 years, he says, then discharge all but the best non-commissioned officers and men, and let them serve for 10 years more in the Reserve, if they elect to do so. Captain Luard was in favour of conscription. The Hon. Percy Feilding proposed obligatory Militia service for one year, and long service for the active army. Lord Elcho said the law of our home army, the Militia, is that of universal personal service. The Prussian law is taken from the English, and our Volunteer would be equivalent to the Einjährigen. M. de Fonblanque, Colonel Aikman, General Marriott, and others, opposed conscription. Mr. Ralph Knox said there seemed to be such a diversity of opinion amongst officers about what should be done, that the nation could not find out

what the experts really proposed. Now to-day I am glad to find there is a great deal more unanimity. There is one thing that I think every one has advocated, and that is compulsory service; whether it should be compulsory service throughout the world or compulsory service for the protection of England only is, no doubt, a matter on which there is a difference of opinion, some advocating the one and others the other system. But there is no doubt that we are entitled to the service of every man in the country for home defence; he must serve either in the Militia, or the army, or the Volunteers. I think that we are doing our duty in this theatre in coming to some conclusion about this matter. It must be compulsory service for the defence of England, but for the defence of the Imperial frontier in Asia, Africa, and America we must have an army to go abroad, and, I think, there is no doubt that if we had compulsory service for the Militia, and also the Volunteers well kept up, there would be not the slightest difficulty in feeding the Line, and keeping up an army sufficient for all our duties abroad. I beg in your name to return our best thanks to General Tyrrell for his lecture.

Friday, April 28, 1893.

SIR FREDERICK BRAMWELL, Bart., D.C.L., LL.D., F.R.S., in the Chair.

ON THE PHOTOGRAPHY OF FLYING BULLETS BY THE LIGHT OF THE ELECTRIC SPARK.

By C. V. BOYS, Esq., F.R.S.

THE subject upon which I have to speak this afternoon, though it may appear highly technical, is, nevertheless, one which will, I believe, be found to be of general interest. The subject, as the title sufficiently indicates, deals essentially with the examination of things which are moving at a high speed, either by means of the eye itself or photographically. Before I speak of such speeds as those with which we have to deal when examining projectiles, it is perhaps best to lead up to them, as we are not able altogether to appreciate by mere figures the difference between such velocities and those with which we are more familiar. Of course, when we wish to see or to photograph a thing which is moving very quickly, it is necessary that the eye or the camera should be exposed to the thing for an excessively short space of time—for a time so short that it has not time, in that short interval, to move through a distance which is appreciable. If the eye or the camera is exposed for so short a time as this, the thing in passing by will appear to be at rest; or, on the other hand, if the eye or the camera is continuously kept exposed to the thing, but in a dark place, and the object is illuminated by a flash of light, which itself lasts so short a time that during this time the thing has no time to move through a distance which is appreciable either to the eye or on the photographic plate, the object will again appear as if it were at rest.

Of the two methods—that of exposing the eye or the camera for a very short time, and the other method, the use of the flash of light—the first is that which is best known to photographers in general: it is the method of the rapid shutter, which every amateur photographer, of course, uses to-day. That method is not altogether available in the present case, and, therefore, I shall be dealing almost exclusively with the other, that of photographing the body by a so-called "instantaneous" flash of light. I have, however, owing to the kindness of Mr. F. J. Smith, a photograph taken by the first method, with the shutter, which is the most beautiful example of a photograph

taken in this way that I have seen, and, therefore, with your permission, I will throw it on the screen.

In this particular case, Mr. Smith took with a camera an express train passing him at the rate of 100 miles an hour. He was in one express train travelling in one direction, and he waited until another express came by in the opposite direction, which happened at the station of Brent on the Great Western Railway; and it so happened that the two trains between them made up 100 miles an hour. This speed is, of course, from one point of view, a very moderate one, but the photograph is extraordinary in its perfection. However, we are dealing here with such a small speed, only 100 miles an hour, that any apparatus which answers well for that, may be perfectly useless when we come to such speeds as 1,000 miles an hour or more.

The other plan commonly made use of is that in which a flash of light is employed. The magnesium flash is very largely used by photographers for the purpose of taking portraits. The next slide illustrates what may be done with the magnesium flash. The lower part of the slide is a photograph of the eye of Mr. Colebrook after he had been some minutes in a dark room, by which time the pupil was fully expanded. Then a sudden flash of light was produced by burning magnesium in which the light lasted so short a time that the involuntary muscles of the eye had no time to act. As is well known, they cause the pupil to contract in the presence of strong light to save the retina from the glare. The result is that the eye is photographed with the pupil open to an extent to which you never see it. The upper part of the photograph is the same eye taken immediately afterwards in daylight, showing the pupil open to the ordinary extent. The magnesium flash, although not in reality instantaneous, lasts so short a time that from the point of view of the taker of portraits it may be considered and rightly described as instantaneous.

I have a very simple experiment to show that this light is not by any means instantaneous. We have a disc with coloured and black and white sectors painted upon it. That disc is made to revolve at a high speed, and then the colours vanish, and the whole disc appears a uniform light grey and pale white. Now, if the flash of light by which we shall in a moment see the disc is truly instantaneous, those colours will all appear clearly again and seem to be at rest. You will have seen that the disc appeared to have no coloured sectors on it at all; it seemed just as uniformly grey as it appeared when it was rotating in the ordinary continuous light.

Now, I should like to show you, by way of contrast, that same disc revolving in the same way by the light of an ordinary electric spark. I have here a very powerful Wimshurst electrical machine eminently suitable for this kind of experiment, connected with a battery of Leyden jars. Every time one of these sparks occurs, the disc, although revolving at a high speed, as you can see by the faint light in the room, is apparently absolutely stationary. That is sufficient to show that an ordinary spark by comparison with a magnesium flash lasts, as far as we can at present tell, no time at all. But an

electric spark can no more be really instantaneous than anything else, even though to our senses it may seem so, and in proof of that I will ask you to look at the next photograph on the screen, a photograph taken by the very same sparking apparatus which was used for illuminating that disc. At the small speed that we have here, or at much higher speeds, that spark seems instantaneous; but let the object pass at the rate of 1,600 miles an hour, the speed of the magazine rifle bullet, and you find, even with a light so instantaneous as this, that the bullet has time to move a quarter or a half inch, so that the light is not instantaneous at all. It is necessary, for the purpose of photographing bullets travelling at these high speeds, to get something more instantaneous—I do not say than the electric spark, but—than an electric spark produced with no special precautions, with the object of making it last as short a time as possible.

In order to reduce the time the electric spark lasts, it is necessary to do away with all superfluous wire. It is necessary to abolish magnesium for the terminals, because, although it gives a brilliant spark, the vapour of magnesium takes a long time to go out; and the wire not only must be short, but it must be thick and as broad as possible, and it is not permissible to employ a battery of Leyden jars, for that will make the spark last longer again. I made a series of experiments at South Kensington last year, with the assistance of Messrs. Edser and Stansfield, two of our students, with a view of changing from the spark we have here to such a spark as is suitable for the purpose of bullet photography. In each case the duration of the spark was examined by means of a mirror, which we could drive continuously at the enormous speed of more than a thousand turns to the second. It was made by Mr. Colebrook, and is a beautiful piece of work. The next photograph shows how such a mirror may be used for the purpose of examining the duration of one of these sparks. The mirror in revolving will throw the image of the spark on the photograph plate, and if the mirror is revolving the image will travel on the plate, and one can make the image travel at a speed the value of which can be accurately determined.

In this particular case the spark suddenly began at the moment the image was projected upon a particular point on the plate, and the image would be represented, if the mirror were at rest, by an exceedingly fine vertical line; but the spark, when it began, did not immediately go out. It took a little time to get up to full brilliancy, then began to go out slowly, lighted up again, and the middle part of the spark seems to have gone out, but the two ends—the top and bottom of the sparks—kept alight a long time, and the mirror drew out the image of the ends into two long lines before the light was extinguished. Knowing how fast the mirror was turning, and how far it was away from the plate, it is a simple matter to calculate how long it would take for the image to travel any particular distance upon the plate. A series of marks, corresponding to one millionth part of a second each, have been made so as to form a time scale, by means of which the duration of the spark may be immediately read off. It appears from this that the light of the middle of the spark was some-

thing like half a millionth part of a second—by no means instantaneous—and that the two ends of the spark lasted six or seven millionths of a second.

I will not weary you by showing more than one other of these trails, though many were taken with a view to obtain a suitable spark. It is the photographic trail of a spark made with the apparatus that we considered suitable for the purpose of taking photographs of bullets. In this particular case, you will see the image is practically extinct in a very short time, just about one twelve-millionth or one thirteen-millionth of a second; there is, besides, a feeble light, lasting for about half a millionth of a second, and after that there is no light whatever. You may say, practically, the whole photographic work is done by the light in about one ten-millionth part of a second, because the very faint light afterwards has no action on the plate which has previously been illuminated by a very strong light. We may, therefore, say we are dealing with a light which lasts about one ten-millionth part of a second. In that time a bullet, travelling at the enormous speed of 2,000 ft. a second, cannot move more than one 500th of an inch, an amount, at any rate, too small to be distinguishable, and we have, from the point of view of the bullet photographer, an instantaneous flash of light. Just as we saw the magnesium flash was practically instantaneous until it failed under a more severe test, and the ordinary electric spark appeared to be instantaneous until it failed under a more severe test, so here we have a light which, tested by such a moderate speed as that of the rifle bullet, appears to be instantaneous, still, when examined by the severe and powerful means of the revolving mirror, is found to last a time which may be fairly accurately measured.

Having now explained shortly what can be done in the way of getting illumination suitable for the purpose of photographing bullets in their flight, I must next give all the credit that is due to the inventor and originator of the process of photographing bullets by means of the electric spark. I refer to Professor Mach, of Prague. Some eight or nine years ago he made experiments in this direction, and after some time he succeeded in perfecting the apparatus with which he has now carried out a very large series of experiments in Austria and Germany. The next photograph will show a diagram of the apparatus that he used, and this will show, moreover, how it is possible to get a spark at the exact time that it is wanted. The arrow represents the path that the shot will take after it has been fired from the gun. It also represents the Leyden jar and other apparatus, which I need not now describe. The dotted lines represent wires forming the discharge circuit in which there are two gaps. When the Leyden jar is charged electrically it discharges at these two places, but if it is only charged to such an extent that while it is unable to make two sparks, one at each place, it is, nevertheless, able to, and at once will, make a spark at one place when the second gap is closed by the bullet or other conductor, then if the bullet comes along and joins the two wires the electricity takes the opportunity and makes the spark just when the bullet gets to the right place;

the camera is focussed upon the spark gap, which is to be closed by the bullet, and will receive an image of the bullet as it passes.

The next photograph will show one of Professor Mach's results, which he has been good enough to send me. You see the shot coming along, and, after what I have said, it is not surprising to see the photograph of the shot. The wires are shown, but, in addition to the photograph of the shot and the wires which the bullet strikes in its journey, certain curious shades are seen, one in advance of the bullet and one from the tail, while a trail is left behind very like that seen in the wake of a screw steamer; in fact, the whole atmospheric phenomenon accompanying the bullet is not unlike that seen on the surface of water surrounding and behind a steamship in motion. Those waves had never before been seen, but their visibility was predicted by Professor Mach, and the photograph verified his predictions. These waves form the most interesting feature of this subject, because the waves accompanying the bullet give some information as to what was going on immediately before the taking of the photograph.

The next photograph shows a modification of Professor Mach's apparatus which I devised a little more than a year ago, which has, at any rate, the merit of extreme simplicity. I took a plate of window glass, a little more than a foot square, with a foot of tinfoil pasted on to either side of it. Very short and broad copper bands, making good connection with the tinfoil by long strips of copper foil, complete a circuit in which two spark gaps (*a*) and (*b*) are included, at which sparks are formed on the discharge of the condenser. In virtue of the shortness and breadth of the bands, the sparks produced are very brilliant, and are made in less time than that which would be necessary if the electricity were taken a long way by means of a wire. But the question is how to get sparks at the right moment. There is a second small Leyden jar, of very small capacity, connected with the plate of window glass, one surface of each by a wire, and the other by a wet string, shown by the dotted line in the photograph. By using a solution of chloride of calcium, the string retains its moisture and partial conductivity as required. So long as the gaps at (*a*) and (*b*) are open, the little condenser, which is kept at the same potential as the large condenser by means of the wire and wetted string, is unable to make a spark both at (*a*) and (*b*), but it could, if the circuit were closed at either gap, discharge it at the other. As soon as the bullet comes along and joins the two wires, and so closes one of the gaps, the little jar takes the opportunity to discharge. The spark is, however, so small, owing to the small capacity of the little jar, that its brilliancy is not sufficient to affect the photographic plate, but it is sufficient to affect the conductivity of the other spark gap, so that the condenser, finding one of its gaps in a conducting state, discharges, and makes a brilliant spark at the other exactly at the time it is wanted, so that in this way we get a spark at the right place and at the right time. The use of a pilot spark, which would fog the photographic plate, is avoided, and, moreover, if the plate and the spark are on opposite sides of the bullet but

the plate is much nearer than the spark, a sharp shadow is cast upon the plate and is photographed, and now, in consequence of the absence of the considerable absorption for the peculiar light of the spark by glass, a smaller condenser and a smaller spark and a spark of less duration may be employed than would be necessary under similar circumstances if lenses were employed, and still quite sufficient light is produced to act upon the plate.

The next photograph is a perspective view of the apparatus that I used in position. It was placed in one of the passages at South Kensington, where I carried out the experiments. There is not very much to describe. The rifle is placed upon two V's so that the aim is definite, the bullet passes through a paper tube, and so into a rough box in its passage through which it is photographed. After leaving this by a second tube it is stopped gently by entering a box filled with bran. The tubes at each end of the photographic box have a piece of card placed across, so that the bullet can find its way in and out again without letting light in. The photographic plate is placed at the back of the box. The spark is made inside a projection from the front of the box, and the little auxiliary spark, due to the very small Leyden jar, is made at a point where it can be seen by the operator, so that he can tell by observation if the other spark has gone off at the right time. The two wires are placed just in front of the plate in the line in which the rifle is pointing.

The next photograph shows the result of a preliminary experiment made with odd scraps of wire, &c., that were at hand, in the course of half an hour or so, to see whether the idea was practicable, and before any precautions had been taken to make it work as well as possible. As the photograph shows, the first shot was successful, and the result was sufficiently promising to show that a good photograph might be obtained in this way. In this case we used the magnesium spark for the sake of the intense photographic light that it gives. I did not know at that time that it lasted so long as to be unsuitable for the purpose. However, on putting up the apparatus shown in the photograph, in which the points that I have explained were carefully attended to, I was able to get better photographs of other objects.

The next slide shows the bullet of the Martini-Henry rifle passing by, and an examination of the ends of the bullet shows them to be perfectly sharp. There is no sign on this account of any movement of the bullet. On the other hand, there is no doubt that it was moving, because the end of the wire has been cut into little bits by its passage, and a splash, due to the collision, is evident. The instant the bullet reached the second wire, the spark was let off, and the photograph taken. The atmospheric wave is clear and sharp round the head of the bullet, and certain other waves, which I will dwell upon later, are also evident. You will remember that in the last photograph showing the pistol bullet there were no waves at all, but in this photograph the waves are perfectly clear and remarkably sharp, being represented by a pair of lines, the outer one dark, and the inner one light.

The next photograph shows the magazine rifle bullet passing by at a still higher speed. The Martini-Henry bullet was going about 1,295 ft. a second, but in the case of the magazine bullet we are dealing with a speed of about 2,000 ft. a second or rather more, and still the bullet appears sharp. In this case the nose of the bullet is enveloped in a splash, due to the contact between itself and the first wire. The atmospheric waves are more conspicuous than before, and what I wish specially to point out is the fact that they are inclined at a steeper angle than before. It is not difficult to see why these variations of angle occur in the atmospheric waves. Suppose a bullet to be travelling along in the path of the bullet, and to have arrived at some particular point, and suppose also that it is moving at twice the speed at which sound travels in air, which is very nearly true in this particular case. Sound travels at 1,100 ft., and the bullet at nearly double that speed. In the time that the bullet required to get from any particular point, *a*, to its present position, the atmospheric disturbance or noise set up at *a* can only have reached to a distance in some direction or other equal to half the distance of the bullet from *a* to its present position. If you take another point a little further on than *a*, the disturbance will not have travelled quite so far, and point by point if you take the distance to which the atmospheric disturbance can have travelled each time, being half the distance that the bullet travelled from the point chosen to its present position, you will find a series of points in a straight line pointing to the place up to which at the particular moment the bullet has reached. Thus the faster the bullet is travelling the greater will be the bullet's journey in comparison with the distance travelled by the atmospheric disturbance, that is to say, the faster the bullet is travelling the more sloping will the atmospheric waves be. In the Martini-Henry bullet travelling a little faster than sound, 1,200 ft. a second, we find the atmospheric wave almost vertical, it has almost kept up with the bullet; in the case of the pistol bullet travelling much more slowly, only 750 ft. a second, the disturbance was always in front, and there were no phenomena stationary with respect to the bullet, and therefore there was nothing to photograph. In order to illustrate this relation between the velocity of the bullet and the velocity of sound in the air, or the gas through which it is passing, I took a couple of photographs which you will now see upon the screen.

The first of these is a photograph of a little bullet made of aluminium which, in virtue of its extreme lightness, travels about half as fast again as the bullet of regulation pattern. Its speed reaches about 3,000 ft. a second, and in consequence these waves are much more inclined than in the last case, as is evident at once. In fact, it was from the inclination of these waves in this instance that we obtained a measurement of the speed. In addition to that, velocity is imparted to small pieces of card, because the bullet, in making a hole in a sheet of cardboard placed some way back, caused the little particles of card to fly forward, and they are shown coming along behind the bullet; they have lagged behind the bullet, which

indicates that they are travelling more slowly than the bullet. The waves that those pieces of cardboard produce show that they are still going more quickly than sound or than the bullet of the Martini-Henry. Moreover, as the pieces at the back of the slide have lagged behind more than those in the middle, they must be travelling more slowly, and this is represented by the smaller inclination of the waves from the more backward pieces, in fact at the extreme edge of the plate the waves are almost perpendicular.

In the next photograph we have an ordinary rifle bullet travelling at ordinary speed, but the waves formed in this case are still more inclined. This is due to the fact that the box was filled with a mixture of carbonic acid gas saturated with the vapour of ether. Through such a very dense gas weighing about four times as much as atmospheric air, sound can only travel at about half the speed that it does in air, and in consequence the bullet appears to be travelling twice as fast as it really is. It does travel twice as fast in relation to the speed of sound through the gas in which it was photographed.

The next photograph is one of an earlier series in which there is a phenomenon which is worth pointing out. The bullet struck the little bead on one of the wires just before the electrical arrangement was ready to go off; I suppose it was not quite sufficiently charged, but it went off very soon afterwards. The result of the collision was of course a violent click; it would have been heard as such if it had not been for the noise of the explosion. The noise due to this collision, however, travels away in all directions, at the usual speed, about 1,100 ft. a second, and we have here a photograph of that noise, showing how far it had got. If you were to look at the negative, you would see that it had travelled through a distance of about one-twentieth part of an inch, and knowing how fast sound travels, one gets immediately a measure of time that elapsed after the collision before the electric spark was let off, namely, about the two hundred and sixty thousandth of a second.

The next photograph is one which will be, I think, especially interesting to a good many members of this Institution, for I believe it provides a means, I won't say of solving, but of throwing some light upon one of the difficult problems of the day. It is a photograph taken with the object of finding out how much of the velocity of a shot is acquired after it has left the muzzle of the gun. There is, of course, acceleration as long as it is inside the gun, because there is a tremendous pressure behind it, but it might be supposed that as soon as the shot gets outside the barrel the acceleration ceases, and that immediately it begins to be affected by atmospheric resistance causing dimnuition in speed. But if you bear in mind what a tremendous draught there is in front of the gun—and in the case of a large gun this power of the draught to move heavy things at even a considerable distance in front is well known—there can be no doubt that when the bullet is outside the gun there must be a most tremendous rush of gases upon the base and past the sides of the bullet which must tend to accelerate it. At any rate, as long as there is this rush there

can be no retardation due to atmospheric resistance. The question is, how much of the velocity of a shot is given to it after it has left the muzzle of the gun and at what point is the velocity a maximum. Chronographic measures for determining this are necessarily difficult to make, and those taken by means of the crusher gauge may well not altogether agree. Any method independent of these two which may tend to verify one or the other, must have a certain amount of interest. The process which I have tried provisionally is as follows: A shot is drilled through transversely so as to form a series of holes, each one slightly inclined to the last one. Suppose we drill a hole through the nose of the shot, and all the way down it a series of holes, each one so much inclined, and only so much inclined, to the last as that one of them in any case, and perhaps more than one, will, as the shot goes on its way revolving, allow the light of the spark to shine through it on to the plate, there will be no doubt after an examination of the photograph of such a bullet which of the holes was the one pointing to the spark, and therefore if the inclination of this hole to the horizon were known when it was in the breech, the angle over and above an exact number of half turns made by the bullet in its journey from the breech up to the point at which it is photographed will also be known. In this particular case there is the clear spot of light showing the position of the hole. It would be more visible but for the fact that the lead inside these copper-coated bullets is driven forwards slightly by the violence of the explosion, and the hole instead of being round, is lens-shaped, in consequence of the forward shear of the lead. You can see the form of the hole on the negative corresponding most beautifully with the actual hole in the bullet. The distance that the bullet travelled from the breech up to the point at which it was photographed is known, and therefore the number of turns that it would have made in this distance is also known if the pitch of the rifling was maintained. It is one turn in every 10 ins. So that we know exactly at what angle that hole would have been lying with respect to the horizontal at this particular point.

Now, supposing none of the velocity of the shot to have been given to it after it had left the gun, the screw movement which occurs in the barrel would, for that short distance at any rate, have been completely and perfectly maintained outside, and every 10 in. the shot would have made one exact turn. But if, after it had left the muzzle of the rifle, it were blown forward by the powder gases, then that would produce a forward acceleration, but would not produce any rotational acceleration, and, therefore, the twist would appear to have lagged behind with respect to the forward movement—the pitch would be increased. That was the case. It was found not to have turned exactly one turn in every 10 in., but to be a few degrees behind its proper position. The velocity given to the shot outside in addition to that given to it inside the gun is a little under 2 per cent. I do not give these figures (the result of a single preliminary experiment) with any certainty of their being perfectly correct. The method I believe to be available for the purpose of getting a fairly

accurate solution of this problem. I do not bring this forward as practically deciding the matter, but merely as being likely to afford additional and independent evidence if it should be needed.

The figures on the next slide are taken from a paper published by Mr. Scott-Russell nearly 50 years ago, and read at a meeting of the British Association. They represent certain properties of water waves, and the bearing of this upon our subject will be evident in a moment. In the case of ships travelling through water at a low speed, the chief resistance that they meet with is due to skin friction; but when the ship is travelling at a high speed, waves are formed which become more powerful as the speed increases, and these waves increase very largely as the velocity increases, and after a time it comes about that more than half the work done by the engines is not expended in overcoming skin friction, but in producing waves, and as the waves go on increasing in size, the resistance increases in a very high ratio. In the case of the rifle bullet at low speed, the main resistance is due to skin friction. As the speed increases, the resistance increases; at high speeds a new form of resistance is added, due to the generation of these waves. The two cases run very nearly on parallel lines. In each case the resistance at high speeds is in the main due to the generation of waves. The property that Mr. Scott-Russell was representing in this photograph is this: that whereas a single solitary wave meeting a wall is reflected, so that the reflected wave is in all respects similar to the advancing wave, that is to say, when the wave meets the wall at a moderately small angle, and the same is true as the angle is increased; on the other hand, when a wave, which is advancing so as to make an angle not very different from a right angle with the wall, *i.e.*, when it meets the wall at an almost grazing incidence, reaches the wall, then there is no reflection at all. In such a case as is represented here, the wave is not reflected, but the energy which ought to be expended in producing the reflected wave is taken up by the advancing wave, and the portion of the wave near the wall being taller and stronger, travels, in consequence, at a higher speed. It gets ahead of its proper place, and the form of the wave ceases to be straight. It becomes curved, until at last the part nearest the wall becomes so high as to form itself into a breaker. I thought it would be an interesting thing to make an exactly analogous experiment in the case of the air waves produced by the passage of a bullet. In this case the bullet was fired as usual. A sheet of metal was laid along so as to be seen edgeways from the position of the spark and so as to catch these two waves produced by the head and tail of the bullet; the wave meeting the surface at a moderate angle is perfectly reflected from the surface. The dark and the light lines indicating a wave are inverted after reflection as they ought to be, as the light line follows the dark one. I ought to have explained the reason that these waves are visible. They are shells of compressed air, and a ray of light striking one of these shells anywhere across the middle passes practically straight through, but a ray striking the edge where it almost grazes it is refracted inwards very slightly, and

so it misses the point on the plate that it would have reached had it not been for the refraction, leaving a dark place there and making a bright mark within the wave. The series of tangential rays thus leave a dark line and produce a bright line just within in the case of a wave of compression or without in the case of a wave of rarefaction. We thus see that the tail wave is also a wave of compressed air. I cannot explain the fact that the outside is dark and the inside light on any other supposition.

I was showing that these waves are perfectly reflected. I placed two plates of metal in such a position that in one case it would be very nearly at right angles, and in the other case inclined at an angle still less than a right angle. In the first of these there is absolutely no reflection, but the part of the wave near the reflector runs ahead, gets a little stronger, and it curls round a little, behaving exactly as the water wave did. In the other case I happened to just hit off the intermediate point at which there is some sign of reflection, and some sign of this running ahead. This experiment may be of some interest in connection with deflections which must occur when bullets are fired in the neighbourhood of walls. Supposing a bullet to be passing within a few inches of a wall and parallel to it, then, if the bullet is not travelling at a very high speed so that the waves come down at a low angle, the wave on the wall side will not be reflected, but will run ahead and keep up with the bullet, and there will in consequence be a higher atmospheric resistance than on the opposite side, the effect of which must be to produce deflection of some sort. I do not say driving the bullet away from the wall, because when we are dealing with rotating things the effect of any applied force or couple is so surprising—it may be to attract it, but it must have an action on the bullet, not merely a small action, but a considerable action, for the effect of the resistance due to the atmospheric waves is so great. But if a bullet is going at such a speed as to make waves strike the wall at an angle at which they can be reflected, then the waves will be reflected and return behind the bullet. Now no action which occurs after the bullet has gone can in any way affect it.

There is one question which has given rise to a good deal of discussion which perhaps can be solved by photographs taken in this way. In the choke-bore the shot produce a better pattern on a target than they do when they are fired from the cylindrical barrel, and it is concluded that the shot will strike an object more violently in this case than in the other case, where there is more lateral spreading. It has, however, been urged that if the object fired at, say a pheasant, flies across the line of fire at a high speed, then, even though the shot may by the action of the choke-bore be caused to make a better pattern, that is to say, to go through a smaller ring, it does not follow that they are not drawn out into a long line, in which case a bird flying by quickly may only be hit by a few pellets, whereas even though they were laterally spread rather more it might, if they were longitudinally closer together, have been hit by far more. Whether the one view or the other is correct I am not able to say, because I was

not able when I took the photographs to get away to a distance sufficient for settling the matter completely. At any rate, the photographs show that there is no difficulty in seeing what is going on. In the first of these photographs shown the shot are fired from the choke-bore barrel—the left-hand barrel of the gun. The shot are perfectly clearly seen, and I will ask you to see to what extent, after travelling 3 or 4 yds. only, they are laterally scattered, and to what extent longitudinally. The large object following the shot is the wad.

The next photograph is the corresponding one, taken under exactly the same circumstances, with the right-hand barrel. At this short distance the difference in the longitudinal and lateral scattering cannot be very much, but the photograph does tell us that there is no difficulty in getting information in this way. You see every individual shot clearly and definitely, and the shape of each. The atmospheric waves in this case are not due in the least to the action I have already described. They are merely due to the fact that the powder gases are moving along with them, and that we have here a very imperfect mixture of powder gases and air. These veins or striæ are produced by the light of the spark passing through the gases of different refractive powers, and becoming deflected owing to their imperfect mixture, just as you see striæ or veins when you first mix whisky and water together, and which disappear when the mixture is complete. I may point out that I found it was quite impossible to get photographs of shot with any certainty so long as two fine wires alone were used, as in the case of bullets, to make the necessary contact, because invariably the shot came and destroyed one of them before a sufficient number of shot bridged across from one to the other to allow the spark to pass. But by using thick copper wires, one bent in the form of a screw, with the other along the axis, no such failure can occur. You cannot shoot one of the wires away without knocking it against the other, and since I adopted that plan I have never had a failure.

The third of these photographs is simply one taken to test a statement which I have often heard. It is that if you put a few drops of oil in a cartridge the oil causes the shot to hold together to a certain extent, so that they behave very similarly to shot fired in a wire cartridge. Of course solid grease may well hold shot together; but in the case of liquid oil, as the photograph shows, they are rather more scattered than before.

The next series of photographs is one simply taken with the view of seeing what happens when a bullet goes through a piece of glass. It is not a matter of any importance, but it does serve to show incidentally that one has by using the spark photograph the means of examining rapidly moving objects with a degree of minuteness and accuracy which, I think, at first would not be considered possible.

In this case a sheet of common plate glass was used. The wires were so arranged as to photograph the bullet as soon as the head of the bullet had just penetrated the glass. The photograph shows the flying glass. It does not fly most violently forwards, as certainly

one might have expected, but the splash is most violent backwards. There is practically an explosion at the point where the bullet strikes, and out comes the glass in the finest powder, backwards, and in the short time that the bullet has travelled a quarter of an inch this glass dust has already travelled to a distance five or six times that of the bullet, that is to say, a speed of about 10,000 to 12,000 ft. a second has been acquired in less than a two hundred-thousandth of a second. The photograph also shows the same phenomena that I have pointed out in the case of the aluminium bullet. A piece of card was placed just outside the plate, and the bullet fired through it first and the glass afterwards, and it will be seen that those little bits of card, which have nearly kept up with the bullet, have made waves of much the same inclination as those due to the bullet itself. We find that as the pieces lag behind more and more, the waves become more and more perpendicular until they entirely vanish, and the pieces are, so far as you can tell, perfectly at rest; they are really travelling at less than 1,100 ft. a second.

In the next photograph the bullet has travelled a little further through the glass plate, but it shows a good deal more than one might expect. The edge view of the plate is clear and sharp. A tremendously strong new atmospheric wave is beginning to be developed, due to the compression of air in front of the plate, but there are in front of and behind the plate a couple of inclined waves, to which I wish to draw your attention. In the first place, the inclination tells us that sound in air travelled from any point in the plate to the nearest point in this wave, in the same time that the disturbance in the plate travelled from the same point to that point in the plate at which the wave meets it, that is to say, about ten times as fast as sound travels in air does this ripple, this shiver or shake, travel down the glass plate—about 10,000 ft. a second. Secondly, if you look at this wave you will see that one part is dark outside and light inside, indicating compression. A little lower down the wave is light outside and dark in, indicating rarefaction, and so it alternates. We have, therefore, the first movement of the glass at one point, giving rise to a wave of compression, it must have been a forward movement; the first movement of the glass at the second point, making a wave of rarefaction, must have been a backward movement, and so on alternately. You get from the photograph the wave-length of the ripple or disturbance that ran through the glass, and you find that this view is verified, for if one of the waves produced on the two sides—front and back—is a wave of compression, the one at the corresponding position on the other side is a wave of rarefaction. The wave has been reflected from the edge of the glass, and is now on its way back. Its boundary is defined, for there the atmospheric wave due to the disturbance meets the glass. This shows also that the glass up to the present moment has not been broken. A wave cannot travel at a definite speed, or at all, through a glass plate which is broken; the plate must still be whole, otherwise the wave would not have travelled on its return journey so far. If I had taken a photograph of the bullet further and further through, we should have

been able to see the point at which the wave ceased to be continuous, and thus have found out up to what moment or place the plate remained whole.

In the next photograph we have a bullet taken a good deal further on. In this case the bullet has travelled about 5 in. beyond the plate, and we might have imagined that the bullet would have escaped completely from the *débris*, but it has done nothing of the sort. It is entirely surrounded with a mass of fine glass powder, little bits of which are each producing its own individual wave, and the new wave of compression is a magnificent wave which it is almost impossible to believe can be due to compressed air, it is so sharp and black. There are some indications of the waves due to the rippling of the glass, which were so evident in the last photograph. In this case it is evident that little bits of glass are coming out from all parts of the plate, which still appears whole and to be standing upright. It is there, but it is not a complete plate at all. It is entirely broken up. The individual parts have not had time to fall down or get away, but their grinding edges have kicked out little bits which are visible on either side of the plate.

In the next photograph the bullet is about 15 in. past the plate. The glass is coming along with the bullet, more or less lagging behind, and the little waves due to each fragment produce an extraordinary cross hatching. The middle piece of the glass plate punched out by the bullet is coming along just above it, and at about the same speed. This we know, because the wave due to the bullet and the corresponding wave due to the glass plate make, as far as the eye can judge, exactly the same angle with the horizon, and, secondly, if the piece of glass were not going at much the same speed as the bullet it would not have kept up with it.

The next two photographs show the remains of the glass plate in two later stages. In the second the separate small pieces have moved far enough to be separately distinguishable. In both we see that the very rapid backward splash was composed entirely of the finest glass powder, and that pieces of appreciable size only go forwards, which some of them do with sufficient velocity to pierce the side of the box.

The last photograph shows what a beautiful pattern is produced in a glass plate when a bullet goes through it at these high speeds. It is commonly stated that a bullet makes a clean round hole, and sometimes that the hole is smaller than the bullet that made it; but I believe that a much more moderate speed is required. I have not been able to succeed in the laboratory even with panes set in putty to check vibration.

I have now come to the end of what I have had to say, and I must only, in conclusion, express the hope that the general interest in the subject has been sufficient to have made it worth your while to listen to me with so much attention.

The CHAIRMAN: I will now ask the gentlemen present if they wish to make any remarks on this extremely interesting paper that we have had from Professor Boys. I am sure that he will be most happy to answer any question, supposing there are any points that want clearing up, which I rather doubt.

Lieutenant CHARLES H. SCOTT: I should like to ask whether the form of the bullet alters the form of the wave.

Professor BOYS: I sawed off the heads of some of the bullets, so as not appreciably to affect their weight, making the end perfectly square, and it made no difference that was observable.

Mr. JOHN RIGBY: I have listened, with very great interest, to the account of experiments and results reached by Professor Boys in this novel manner. These methods of investigating the circumstances which surround a bullet on its immediate departure from the muzzle are still in their infancy. They are so simple, and the apparatus devised by Professor Boys is so exceedingly practical, that those of us who are engaged in measuring velocities and observing other phenomena with reference to the flight of bullets, will derive much advantage from following out a similar course. I cannot exactly see, and I would ask Professor Boys to explain, how he arrives at anything like an accurate estimate of the acceleration of translatory velocity that a bullet receives after it leaves the barrel. I hope I shall not be considered tedious if I say a few words as to how the matter stands in my own mind, and I will ask the Professor to correct me if I am in error. Up to the muzzle of the barrel the rotation is imparted to the bullet by contact with the rifling. When it leaves the muzzle, it has a rotatory velocity, which is a function of the spiral of the rifling and of the translatory velocity. Once it departs from the guidance of the barrel, no further impulse to increase rotation is given to the bullet. It meets in its course a certain resistance from the air, but I agree with Professor Boys that at the short distance at which his experiment was made, the retardation of the rotation caused by the air may be neglected. In a very ingenious manner Professor Boys has shown us that at a short distance from the muzzle of the gun, he can catch a picture of the bullet in its flight, and determine the position at that moment of one of its minor axes (fixed beforehand in the bullet by drilling a hole). At a certain distance from the muzzle he is able in that way to detect a lag in the rotation. Of course, at that distance, the rotation of the bullet, supposed uniform, depends upon the time taken to go from the muzzle to the particular spot; and if this time were that due to the velocity at the muzzle, and to that distance, we should know exactly in what direction the drilled hole should lie on the photograph. In fact the bullet would follow the same uniform screw motion from the muzzle to that particular point. But if the bullet from any cause is accelerated in velocity, it will not have had time to make the full number of revolutions, and there will be an apparent lag in the rotation, and that is what I understand Professor Boys has observed. But, on the other hand, we know that very shortly after leaving the muzzle of the rifle it is exposed to a very much greater resistance from the air which it has to displace than the pressure of the outrushing gas behind it, and at some distance, probably between the muzzle and the point of observation, the maximum velocity has been reached, and has commenced to diminish. Now, from that point the circumstances are reversed and from it to the point of observation the translatory velocity of the bullet is diminishing, the time it takes to travel that distance is increased, and consequently it will have spun a greater number of times than would be due to the uniform motion from the gun. I think, therefore, that from the muzzle of the barrel to the point of observation two phases of the rotary motion may be seen: viz., a lag up to the point of maximum translatory velocity, and a precedence from that to the point of observation. I should like to know from Professor Boys how he separates those two phases, which are essentially different in their results, so as to arrive at anything like an estimate of the increase of velocity or the distance from the muzzle at which the point of maximum velocity is reached. There is only one other point I would speak of, and that is the circumstances under which the shot leaves the muzzle of the choke-bore gun. The fact that the contraction of the muzzle of a shot gun causes shot to be thrown much more closely is one of rather modern discovery, and it has not been very clearly explained what the action of the choke is; but I would venture to suggest that it is most likely something of this sort. In a cylinder barrel the shot arrives at the muzzle, all the portions of the charge of shot having an equal velocity, and there is no reason why up to that time they should vary. The shot would leave the muzzle in a cylinder with a flat front, on which front

there is the wad used to keep the shot in the cartridge. That wad itself is a cause of the shot scattering. It is quite evident that if you could get rid of that wad without very much disturbance of the pellets of the charge, which are then not confined to the barrel, you would diminish one cause of spreading and inaccurate spreading. If you use the choke-bore, what happens is this. The charge of shot when it reaches the choke, moving all at the same velocity, receives on the surface of the shot a check. The shot along the axis of the bore is not, however, as much checked as the shot in contact with the surface. The outer portion of the charge of shot is held back, as it were, and the shot in the centre of the bore rushes forward with more velocity than the other part of the charge. The consequence is that it would escape from the muzzle with a somewhat conical front. It would in that way get rid of the front shot wad more easily, as it would slide off the side of the cone, and it would also be in a position to meet the resistance of the air more effectively, and, as it were, to pierce its way through the resisting air, without being as much dispersed as in the cylinder bore. I recommend that consideration to Professor Boys, and would ask him if he can detect in these experiments that he has made with shot, whether the choke-bore does deliver its shot with a more conical front than the cylinder bore.

Lieutenant-Colonel FOSBERY, *V.C.*: Some years ago my friend Mr. Metford was watching some rifle practice and turned his telescope on a newly-pointed brick wall in which the white lines of the mortar came out very clearly; as each bullet passed the spot he was observing, he noticed that these lines were distorted over a considerable area, no doubt from being seen through the compressed or rarefied air caused by its motion. Now I wish to know whether it would not be possible to study the air waves we have just seen by some such means, viewing the bullet in its passage past a screen ruled with vertical and horizontal lines which should form a background to the picture and enable us accurately to scale the results, and thus obtain a more perfect knowledge of the nature of these waves.[1]

Captain STRAKER: I should like to ask Professor Boys whether he has observed, in comparing photographs of bullets passing with different velocities, whether the lines of light marking the successive waves of air are always the same distance apart, or whether the distance between them varies with the velocity, and whether he has observed any ratio of variation; also whether the distance between these lines was greater when the bullet passed at a higher speed or the reverse.[2]

Captain ACLAND: I should like to ask Professor Boys whether he has ever photographed the muzzle at the moment that the bullet is emitted from it. The forms of the waves of air and light are so distinct in the photographs shown to us, that it might be possible to discover what was the influence of the escaping gases on the base of the projectile at the muzzle. We might also see the vibration of the metal of the gun at the moment of the shot leaving it, which has, in my opinion, a large influence on the accuracy of shooting, especially in the heavier pieces of ordnance that we use. May I refer also to the point that Mr. Rigby mentioned with regard to the measure of the increase in the velocity from the muzzle, and the way in which Professor Boys has attempted to measure it? The increase noticed by Professor Boys is so small, 1 per cent., roughly, that I think it may more likely be due to the bullet starting at first on a perfectly straight course before taking up rotation in the barrel than to any increase of velocity of translation outside the barrel. Unless you can arrive at what is the distance the bullet travels before it begins to rotate, you can get no accurate measurement (certainly

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[1] If such a plan should be adopted, the bullet might be observed either passing the screen, or as fired at any angle to the same.—G. V. F.

[2] On thinking over the lecture afterwards, I doubted whether the two (or more?) wave lines appearing in the photographs shown were, as I supposed, *successive* waves due to the same cause, and not *distinct* waves produced by different causes. I imagine the question of the movements of air round projectiles moving at different rates could not be fully solved without a much larger plate and without representing the bullet after a longer flight, at a stage when the resistance of the air had had time to accumulate.—J. S.

not within 1 per cent.) of the increase of velocity of the bullet outside. That projectiles go straight before they begin to rotate can be clearly seen by examining and studying the rotating rings of any of the larger projectiles, where the lines of upheaved metal, if I may so call them, show distinctly the amount of the slip of the shot before it commences to rotate—before, in fact, the metal gets sufficient grip to ensure perfect rotation. This is especially noticeable with increasing twist. The motion forward is uniformly in a straight line until the material has risen into the grooves sufficiently to impart rotation to the mass. This may account for some error in measurement, though I hesitate to suggest it to so careful an experimentalist.

Professor Boys: With regard to the method of getting the figure showing the apparent rotational retardation or the actual longitudinal acceleration after the bullet had left the barrel, the process was very perfectly described by the speaker up to a point. It is not an absolutely precise process. The assumption I made was this, that the space over which the acceleration occurred, which is an unknown quantity, was itself small compared with the distance from the muzzle to the place where the bullet was photographed. I think I took half an inch in front of the muzzle as the space in which we could conclude that the acceleration probably occurred. That is one assumption. The other assumption was that the atmospheric resistance as ordinarily occurring in that short distance of 2 or 3 yds. was not sufficient to cause the bullet to have lagged behind its proper place. Of course I may be entirely in the wrong, but I do not think in that distance the atmospheric resistance would cause the longitudinal movement to have been appreciably affected: that is to say, the forces acting in the first case are so very much greater than those due to atmospheric resistance that they have produced their effect in the first ½ in., whereas the retardation due to atmospheric resistance in the remaining 2 or 3 yds. is not sufficient to be appreciable. But it is not necessary to assume that in connection with this method. Of course a single observation can in no case completely solve a question in which there are several independent variables. Theoretically, if one were to take these at two or three distances (assuming that the difficulty proposed by Captain Acland is not a matter of serious consequence—I will come to that in a moment), one would get a means of eliminating the two or three sources of uncertainty. I think these are very small, but there is another method which I have in my mind which I think is available, and that is, to take a gun or rifle with a barrel two or three calibres longer than it ought to be, and drill a series of transverse holes, not too large, for a little way from the muzzle down the gun, so that all, or at any rate most, of the gases will get out sideways, and then fire it; in that case the bullet will as long as it is inside the bore continue the screw motion of the rifling absolutely, and when it gets outside it will not be blown ahead any more, or not appreciably compared with what it would be if the fire could not escape laterally, and therefore the bullet will be only subject to atmospheric resistance, the value of which in that way would be determined.[1] I think that is sufficient to show how the figures may be obtained—that the atmospheric resistance may in that way have its value approximately determined.[2] With regard to the choke-bore, I do not know whether it is known how far the action would be affected by firing a cartridge containing shot of different sizes; whether one might use shot near the periphery of a cartridge of a

[1] The difference in the rotational position, determined (*a*) without and (*b*) with these cross holes, would, at any rate, show the effect of the blast in (*a*) which had been diverted in (*b*).—C. V. B.

[2] It did not occur to me at the time at which I was speaking, though I had had it in my mind before, that the difficulties considered above may be avoided by taking several photographs of the same bullet in its course, the first as near the barrel as the powder flash will permit. Then, by observing the amount of rotation between a series of positions, the pitch of the screw performed by the bullet would be determined, without any assumptions as to the position of the point up to which the acceleration lasted, or as to whether there was any rotational slip in the barrel.—C. V. B.

slightly smaller or larger size than those inside. Of course if that were permitted —if that would not affect the scattering—one could then in the photograph see precisely what had happened to an individual shot or group of shot, and one could see whether the outer shot had lagged behind the inner shot in the way suggested. The suggestion seems to me to be exceedingly reasonable. I may mention that in the negative (it is not so clear in the slide, because the slide has been reduced) the dents in the shot where they have been squeezed together are shown very clearly. With regard to the distortion of the wall, I am afraid I do not quite understand how the wall was observed distorted. Was it at the time the bullet was going by?

Lieutenant-Colonel FOSBERY: Whilst the bullet was going by. The same effect as there would be in the case of rarefied air.

Professor BOYS: I cannot understand that that can be visible to the naked eye.

Lieutenant-Colonel FOSBERY: It was visible with a telescope.

Professor BOYS: I should have expected that the distortion which would certainly occur would be an up-and-down motion, so quickly made as to leave no impression on the eye. I cannot understand its being visibly distorted. I should not have expected it, but if there really is no question about it——

Lieutenant-Colonel FOSBERY: I think not.

Professor BOYS: I do not quite see how the effect of these waves could be observed, because, as they were more and more inclined, they would certainly produce different effects. There would be a different effect if they were highly inclined from what there would be if they were nearly parallel with the line of fire. I do not quite see how you would observe it.

Lieutenant-Colonel FOSBERY: You would be able to observe the smallest distortion of the line at different parts.

Professor BOYS: It would be better to photograph it. If it can be seen it can be photographed; it is possible to photograph very much more than can be seen in a case of that sort. The wall should be illuminated brilliantly by the sun, it should be painted as a black ground with white lines upon it, or *vice versâ*, and a camera should be exposed mechanically for a thousandth part of a second or so when the bullet had reached any part of its course. A beautiful photograph could in this way be obtained which would be much more trustworthy than any eye observation, and it would show much more than could be seen with the naked eye. I should like to see that done. Was the bullet fired from a rifle or a big gun?

Lieutenant-Colonel FOSBERY: Fired from a rifle.

Professor BOYS: It is new to me entirely, and exceedingly interesting. I should certainly recommend it to be photographed; it could be done with perfect ease with an ordinary camera.[1] I have noticed in the case of the two particular kinds of bullets I have used that the distance of the wave in advance of the bullet is different when the speed is different; but unfortunately, in this case, the sizes of the bullets are different also. The Martini-Henry is a larger bullet than the other, and travels more slowly. The distance of the wave from the bullet is considerably greater in that case, but whether that is due to the lower speed or the greater diameter, the experiments, so far as I have gone with them at present, tell us nothing. I am inclined to think, from the general theory of the subject, that the greater distance of the wave is due to the lower speed of the bullet; but I cannot give any definite evidence on the strength of experiment alone. I have not photographed the muzzle of a rifle or gun when the bullet or shot are coming out. I do not yet know whether the flash of the gunpowder itself produces so dazzling an effect as to completely fog the plates, but it is a very simple thing to see whether such a flash in a dark room, a few feet off the plate, would fog it. If it does not fog a very sensitive plate, which has to be developed for three-quarters of an hour afterwards, to any appreciable extent, there will be no difficulty in seeing what

[1] In order to determine to the minutest extent if there were any distortion, it would be best to expose the camera twice, once before firing and once after firing, at a time previously arranged and determined by mechanical means. Then the lines would appear single, except when there was refraction, and the distortion of the lens, if any, would be eliminated.—C. V. B.

happens at the very moment the bullet leaves the barrel. The photograph would be of very great interest for another reason; it would show at any desired stage the bounding surface of the powder gases themselves. The conductivity of the powder gases would, in this case, let off the spark. In this way it would be possible to get a very fairly clear view or measure of the speed at which the gases escaped from the gun compared with that of the bullet, and that might help to throw some light upon the action of these gases upon the bullet when it is outside. I asked some of the authorities, at Chatham, I think, what their view was in the case of the magazine rifle, as to the distance the bullet went before it received the rotation due to rifling. I do not know, as a matter of fact, how far the bullet would travel before it got into the grooves, but I was assured that the distance was excessively small, that the cartridges were made so that the bullet almost immediately followed the groove, and in the case of the bullet of the magazine rifle I have not the slightest doubt that instantly the rotation is taken up. On examining the small, hard, nickel-coated skin with a lens, there is not the slightest sign of any transverse scrubbing at all. There is no doubt there is no lateral slip at all, and how far the bullet goes before it takes up the groove is a question which one could determine without any difficulty. At any rate, in the case of small-arms, there would be no difficulty, for the purpose of experiment, in making the enlargement a trifle short, and in forcing the bullet into its place before firing. In larger guns I do not know what could be done. I should imagine that the ingenuity and experience of the authorities in these matters is sufficient to give them a good idea of what does occur at this stage.

The CHAIRMAN (Sir Frederick Bramwell): I do not think it desirable that I should trouble you with any remarks of mine upon the subject brought before us, and therefore I will simply confine myself to my duty in asking you to return a most hearty vote of thanks to Professor Boys for the extremely interesting and valuable discourse he has given us this afternoon. It is a matter, I think, we may look upon as unique. It relates to that branch of science with which this Institution is particularly concerned. The information which is afforded by this method of investigation is something which, a few years ago, would have been said to be impossible to obtain. However, it is obtained, and it is brought before us. We find, as Professor Boys has said, that the camera can see very much more than the eye can see, and in that manner we have revealed to us that which has taken place in the flight of bullets, and their behaviour as they strike first the air in passing through it, and then solid matter, such as glass. The experiments are of a most interesting character, and I believe that the result of these enquiries will be found of great practical importance in the science of artillery, both large and small. I am sure I have your permission to return your hearty thanks to Professor Boys for his lecture.

Admiral BOYS: I beg to propose a vote of thanks to Sir Frederick Bramwell for so kindly presiding on this occasion.

Lieutenant-Colonel BAYLIS, Q.C.: I have great pleasure in seconding that.

The CHAIRMAN: I do not know why I should be thanked for doing that which has resulted in my spending the most interesting afternoon that I have known for a long time past.

Wednesday, May 3, 1893.

ADMIRAL SIR GEORGE WILLES, G.C.B., Member of Council, in the Chair.

HOW BEST TO SECURE CONTINUITY IN THE EFFECTIVE SERVICE OF MODERN SHIPS OF WAR FOR SUCCESSIVE COMMISSIONS.

By Chief Inspector of Machinery HARRY WILLIAMS, R.N.

THE effective service of every well armed and equipped ship in our navy depends on the competence of the departmental complements to utilize and develop all its power and capabilities as an engine of war.

Probably none of the experienced and distinguished men, members of this Institution, will deny the truth of this proposition, which is laid down as the starting point in the consideration of one of the most important subjects touching the welfare of the navy as a war service.

It is intended, for reasons which will be patent to every one, to deal in this paper with only one department, viz., the engine-room department, and with that portion of this department which may be called the mechanical staff of the ship, composed of engineer officers of all ranks, of engine-room artificers and stoker mechanics of all grades, and any other mechanic ratings which are in any way under the orders of the engineer officer in charge of machinery. These will, in the course of this paper, be termed the "mechanical staff."

We will begin by a statement. At the end of the commission of every ship she is paid off, and there is a more or less complete dispersal of the mechanical staff: that is to say, that those men who, during the three or four years' commission, have acquired a knowledge of the many complexities of the ship and machinery fittings are, on paying off, dispersed, and sent to other ships, where they have again to go through the same process of education in the minutiæ of hull and machinery; and when this training is complete, viz., at the end of the commission, they are again dispersed, to go through the same process. It therefore follows that at the *beginning* of the commission of every ship, none of the mechanical staff have that knowledge of all the numerous and complicated mechanical appliances throughout the vessel which can best be acquired by actual previous service in the ships. Thus there is no *continuity* in the effective service of the ship during successive commissions, because, at the beginning of every

commission, the competence of the departmental complement chiefly concerned is not what it should be.

On ships paying off and recommissioning on foreign stations there may be some attempt to retain some few men who have previously served in the ships, but if so it must be on a very small scale, and on no well-defined principle or definite plan. On ships paying off on the home stations there appears to be an entire dispersal of the mechanical staff, except in the cases of the engineer officers in charge, who, however, are frequently, for very good reasons, transferred to other ships. The result of this system is that, in every ship commissioning on the home stations, there is probably not a single member of the mechanical staff who has served in the vessel during any previous commission.

Now, at first sight, it would seem to be easy to provide for this by simply directing the same mechanical staff to keep serving in the ship for successive commissions, somewhat on the regimental system proposed by a distinguished naval officer; but it will be found, on examination, that this cannot be done, and that the whole subject is beset with difficulties, as will presently be shown.

It may be admitted at once that the regimental system, *if it could be made to work*, would conduce to the continuous effective service of a ship, for the knowledge acquired by the mechanical staff during the first commission would be utilized by their service in her during subsequent commissions. But there are difficulties in the way, which may be stated thus:—

1. As to the regimental system being easily workable.
2. Whether, if it could be made to work, it would be good for the general service.

1. There are several reasons why this system could not be made workable. Take the case of a battle-ship paying off and recommissioning three times on a foreign station. This vessel serves continuously for twelve years on this station. How are the spells of home service, so necessary to the health and recreation of officers and men, to be provided for? Then there is the difficulty connected with the advancement to superior rank or rating, and the exigencies of the Service making it necessary to use these promoted men for service in other ships; and there are other difficulties in the way of any plan being made workable whereby the continuous service of the same men in the same ship for many years could be carried out.

2. If the regimental system could be made to work, would it be good for the general Service? To this it must be answered, that it would be highly detrimental to the navy at large, for it would result in the training of our men into specialists, good only for service in certain ships. But the navy requires that its mechanical staff as a whole should have training in, and experience and knowledge of, all classes of ships, and the many varieties of engines and machinery of all kinds, making, in fact, the personnel of the steam branch of the navy to be good as general service men. A good average all-round man is much more useful for general service than the specialist,

however excellent he may be as a specialist. Now this all-round ability could not be acquired by continuous service in the same ships, and therefore its adoption would be highly detrimental to the naval Service. I am conscious here that it may be thought I have dwelt too long on the regimental system, as to its applicability to the navy, but I have done so for two reasons: first, because it is the only system, except that which will be proposed in this paper, that would provide for the continuous service of a majority of the mechanical staff in the same ship for two successive commissions; and, secondly, because I wish, by stating the objections to it, to prevent, in subsequent discussion, it being proposed as an alternative scheme to that which is about to be formulated.

The question now to be considered is this: Can any workable plan be formulated whereby continuity in the effective service of ships of war for successive commissions may be secured, and likewise provision made for the changes of the mechanical staff from ship to ship, imperatively necessary in the interests of the general naval service?

I will answer this question by submitting a plan, which I consider would be practicable, and which would secure the two great advantages named in the question. In explanation I will take:

1. Ships paying off, and recommissioning several times on foreign stations.

2. Ships paying off, and, after an interval for refitment, commissioning again on the home stations.

These will cover all cases which need be considered by us.

1. *Ships Paying off and Recommissioning several times on Foreign Stations.*

My plan consists of making certain changes in the mechanical staff of a ship *every year, i.e.*, at the end of every year of the commission.

In illustration of this I will take a single ship—a battle-ship of the largest size. Now the mechanical staff of the ship should be not fewer than

Junior (assistant) engineers	3
Chief engine-room artificers	6
Engine-room artificers	12
Chief, leading, and stoker mechanics	6
Total	27

And besides these a fleet and senior engineer, who for the present are not included in the mechanical staff, but whose cases will be dealt with by-and-bye.

We assume that this battle-ship will be employed on, say, the Mediterranean station continuously for twelve years, in four commissions of three years each, paying off and recommissioning at Malta at the end of each interval of three years.

As we have seen, the mechanical staff of this ship should be twenty-seven in number, and one-third of this number should be changed at the end of every year. The following table shows the annual changes and retentions during the twelve years:—

Full Numerical Complement of Mechanical Staff 27.

Commission.	Year, end of.	Changed.	Retained.			
		Replaced by others.	Years' service.		Total.	Total serving.
			One.	Two.		
First	1st	9	18	—	18	27
	2nd	9	9	9	18	27
	3rd	9	9	9	18	27
		27				
Second	4th	9	9	9	18	27
	5th	9	9	9	18	27
	6th	9	9	9	18	27
		27				
Third	7th	9	9	9	18	27
	8th	9	9	9	18	27
	9th	9	9	9	18	27
		27				
Fourth	10th	9	9	9	18	27
	11th	9	9	9	18	27
	12th	9	9	9	18	27
		27				

By the table it will be seen

1. That at the *end* of every successive commission of the ship all the members of the mechanical staff who were in her at the *beginning* of the commission will have been removed into other ships, there to acquire that knowledge and experience necessary in the interests of the general service of the fleet.

2. That at the *commencement* of every successive commission of the ship there will be available for service two-thirds (*i.e.*, 18 out of 27) of the full mechanical complement, who will have had from one to two years' service in the ship, and who by that service will have gained the knowledge of the very numerous hull and machinery connections which can best be acquired by actual service.

3. That after the second year of the first commission every one of

the mechanical staff will serve three complete years in the ship before removal into other ships.

4. That at no time—except the first year of the first commission—during the twelve years will there be fewer than two-thirds of the full mechanical staff with less than from one to two years' service in the vessel.

5. That there can be no reason why the plan should cease to be operative at the end of the twelfth year, *i.e.*, it might be easily extended so as to include the whole active life of the ship.

Thus the continuity of the effective service of the 1st class battle-ship taken for illustration has been secured by ensuring the competence, by actual service, of the department which includes the whole mechanical staff of the ship, a majority of whom would *overlap* from one commission to another.

This plan would apply also to the cases of ships coming home to pay off, recommission, and return immediately to their stations, for it would secure the retention in the ship of 66 per cent. of the mechanical complement, so that at the commencement of the new commission the vessels would have the benefit of the services of these men who by their previous service would have a thorough knowledge of the ships and machinery. In these cases, of course, the whole of the complement of officers and men, excepting the 66 per cent. of the mechanical staff, would be relieved by an entirely new complement.

Now we must go on to consider:

2. *The Cases of Ships Paying off and, after an Interval for Refitment, Commissioning again on the Home Station.*

In these ships the difficulties in the way are very much greater than in those paying off and recommissioning on foreign stations, for we have to consider that these are ships which not only pay off on a home station, but remain out of commission while refitting, or in the reserves, for weeks, months, and even years. How in these cases can the proposed plan be applied so as to secure, when ships are commissioned, that a considerable number of the mechanical staff drafted shall have had from one to two years' actual service in the ship, and by that service have acquired a knowledge of hull and machinery which would be highly conducive to the effective service of the vessels on and from the first day of the new commission? It must be admitted that it is not easy to see how these difficulties can be surmounted unless some alterations are made in the system of the home steam reserves—alterations which will necessitate the sacrifice of some much cherished prejudices as regards the relations between dockyards and steam reserves, and, further, will involve a small addition to the annual naval expenditure, which addition, though small, will yet be large enough to make our naval administrators look somewhat askance at it.

But even these difficulties might, it is considered, be surmounted, if a modification of the plan, already submitted, be applied to these cases. I now proceed to show how this might be done.

In explanation, it will be necessary to refer briefly to a proposal[1] made by me, that the three home steam reserves should be utilized more than at present in the instruction and improvement of all the mechanic ratings of the navy, by their taking a greater part in the repair and refitment of the machinery of all ships being brought forward for commission. This work would be very improving, and the result would be that, in the course of time, the mechanic ratings of the fleet would be more competent than at present to carry out the great work of keeping in the highest state of efficiency the machinery of their ships while in commission, thus rendering unnecessary more or less costly repairs by dockyards. . . . in short, to make, in all commissioned ships, fleet officers and men equal to all fleet requirements. This, it is contended, is a great object, and its successful accomplishment would surely justify a small addition to the normal naval expenditure.

One of the conditions of the scheme was that there should be entered annually such an additional number of engine-room artificers as would enable the authorities to assign to each of the three home steam reserves sixty of this rating, who would be employed exclusively in making good machinery defects of vessels being refitted and brought forward for commission. These men to be exempt in every respect from the performance of ordinary steam reserve duties.

Now, this has a direct bearing on the subject we are considering, for the adoption of this scheme would bring about, not only the improvement of the mechanic ratings of the navy so as to make them competent to keep the machinery of their ships during commission in the highest state of efficiency without *outside* assistance, which would be a great work in itself; but would also clear away many of the great difficulties which stand in the way of securing, that in all ships commissioned at the home stations after refitment there shall be a considerable fraction of the mechanical staff drafted, that will have had from one to two years' service in the ship, either on a former commission, or while in reserve, or refitting.

For with the sixty engine-room artificers available for machinery repairs of vessels refitting for commission, there can be no reason why a number of these men should not be told off and appropriated for service in each of these ships. As before, we will take the case of one of our largest battle-ships, and see how it will work out. We will take one rating only, viz., E.R.A.'s. The full complement, while in commission, is 18, and of these, half, or 9, might be detailed for assisting with the machinery repairs while refitting. Thus there would be 9 E.R.A.'s on board this battle-ship from the day she was paid off, these 9 men having had previous service in the vessel. Of these 9 E.R.A.'s one-third—3—might be changed every year, and the result would be that at all times, and more especially when the ship was commissioned, there would be two-thirds of the—half—complement who would have had from one to two years' service in the ship.

[1] See "The Steam Navy of England" (W. H. Allen and Co.), Part III, chap. ii, pp. 154—159; chap. iv, pp. 178—189.

Thus, in the cases of the ships paying off and, after an interval for refitment, commissioning again on the home stations, the continuity of the effective service of the ships would be secured, by the removal of the difficulties which seemed to bar the annual changes.

Here it may be remarked that, in the case of the battle-ship we have taken, I have suggested the appropriation, while out of commission, of *only* 9 out of the full complement of 18 E.R.A.'s; and the question may be asked, Why not detail the whole complement? The answer is, that this would necessitate the employment of a larger number than 60 E.R.A.'s in each of the reserves for machinery repairs, and there are obvious reasons why it would not be wise to submit too large a scheme; but if the plan were adopted and found to succeed, such an extension of it as would include the full complement might well be made, for, first, these eighteen men would be always doing useful and, indeed, valuable work; and, secondly, they would have a great personal interest in the work being *well done*, for many of them, after repairing the machinery, would serve in the ship in the future commissions.

It will be noticed that the operation of this plan would provide for the spells of home service, which all officers and men should have, for the annual changes would be always going on, whether in or out of commission, and employed on the home or foreign stations.

It may also be remarked that though the single rating of engine-room artificers has been taken for purposes of illustration, yet the plan might, and should, include all mechanic ratings, as *e.g.*, chief, leading, and stoker mechanics, and any specialists included in the complements of our largest war-ships.

A few words as to engineer officers appear to be necessary. There are in all ships larger than 3rd class cruisers two officers whose competence is of special value to the effective service of the ships. These are:

1. The chief engineer in responsible charge of machinery.
2. The senior engineer.

Now, it is essential that these two officers should not be appointed to a ship at the same time; otherwise, when first appointed, neither would have that knowledge gained by previous service in her: at a later time both would possess this knowledge. But in these cases I do not consider the changes should be made annually, as in the case of the other members of the mechanical staff. What is wanted is to ensure that at any time in the active life of a ship one of these two officers shall have served previously in her, if possible, on a former commission. This might be effected by the simple plan of always changing the senior engineer at the end of the *second year* of the commission, and the fleet engineer if necessary on paying off. By the operation of this simple plan, there would be no time during the active life of a ship, when it would be without the services of either the chief or senior engineer, who would by actual previous service in the ship have acquired a thorough knowledge of the enormous number of complex connections comprised in the term hull and machinery fittings, a bare enumeration of which would much

astonish many who imagine they have a fairly good knowledge of the subject.

It is conceivable that a vast amount of confusion, and even serious damage, might be caused by the well-meant action of a few uninstructed men among the mechanical staff of a ship. Does it not show that it would be of great advantage to our costly war-ships, and conducive in every way to their effective service, if, at the commencement of every commission, there was a large fraction of the mechanical staff who had a thorough knowledge of the names, location, and uses of all hull and machinery connections, gained by previous service in the vessels? This is what the foregoing scheme aims at, and will, if worked intelligently, most certainly effect.

I hope I have formulated my plan with sufficient clearness to be easily understood. In the two cases referred to, which probably include all possible cases, viz., all ships paying off and commissioning—

1. On foreign service,
2. On the home station,

I have endeavoured to show how the operation of the plan would effect the continuity of the effective service of ships of war, and how it might easily be expanded so as to include, not only twelve years, but the whole of the active life of the ships.

It will be well now to consider several objections that might be made to the plan:

1. The difficulty of making the necessary annual changes.

To this it may be answered, that there would be no difficulty in doing this in the Channel and Mediterranean Squadrons, for the former is always home once or twice a year, and as to the latter, our troop- and store-ships are continually going to, and returning from, the station; therefore the annual changes might be easily made if some definite and well arranged system be adopted. The same remarks apply to ships employed on the China station.

Now, it is considered that the operation of the plan would be most beneficial in large ships, as, *e.g.*, in all classes of battle-ships and 1st and 2nd class cruisers, and it so happens that the suggested changes can be most easily made in the two squadrons—Mediterranean and Channel—in which are much the greatest number of battle-ships and large cruisers. Indeed, it may be said that, at present, the plan need not be adopted in vessels of, and under, the size of 3rd class cruisers, because in these smaller ships the hull and machinery fittings are fewer in number than in the larger ships. But even in these smaller vessels, it would be well to have an officer and two or three men, at the beginning of a commission, who had previously served in the ships.

It is hoped that these remarks will answer the 1st objection, as to the administrative difficulty in carrying out the annual changes prescribed by the plan.

2nd objection: From the captains of commissioned ships. These might say: "Will it not be hard on us to lose annually one-third of

the mechanic ratings of our ship; and that most valuable officer, the senior engineer, one year before the end of the commission, just when these men know most about the ships by actual service?" To this it may be answered: "It will be hard on you, and a loss to the ship; but the gain will be much greater than the loss, for, by the operation of the plan, every captain would, *at the beginning of the commission*, have a senior engineer, and 66 per cent. of the whole mechanical staff, who would, by a service in the ship of from one to two years, have a thorough knowledge of her in every respect. Not only so, but during the whole commission, he would never have fewer than 66 per cent.—or say 18 out of a full complement of 27—of the mechanical staff, who would be experts because of previous service."

We have dealt somewhat fully with this objection, because it is recognized that there is some force in it, *i.e.*, to changing one-third of the mechanical staff every year during the commission; but it is hoped that it will be seen that the advantages are also very great.

What we are considering here is, not how the service of the ship might be improved, from the beginning of the commission, when the mechanical staff is more or less strange to the ship, to the end, when by service they are as perfect as they can be; but whether, *at all times*, at the beginning as well as at the end of the commission, a continuity in the effective service of the ship, for the whole of its active life, might not be secured by some such plan as that proposed in this paper.

3rd objection: Similarly, the engineer officer in charge of machinery might make the same objection as the captain, viz., that it would be hard on him to lose the services of the senior engineer one year before the end of the commission, and one-third of his mechanical staff at yearly intervals; but he would greatly benefit by the scheme, for, no matter what time he might be appointed to a ship, he would always find on board a senior engineer, and 66 per cent. of the mechanic ratings who would by actual service in her have a knowledge of all hull and machinery fittings and connections. Contrast this with the present system, whereby, in most cases, on commissioning, not one member of the mechanical staff has that knowledge of the ship and machinery which can best be gained by service during a former commission.

I have endeavoured to set forth this plan, and to meet some objections which might be made to it, dealing, first, with the most serious, viz., as to its workability. I will now sum up the various points advanced in the scheme. It aims at:

A. Securing the continuous effective service of all modern ships of war during the whole of their active service, by providing that *at all times* there should be on board a large majority of the mechanical complement who would have a thorough knowledge of hull and machinery fittings, acquired by actual service in the ships.

B. Providing for the changes of the mechanical complements from ship to ship, absolutely necessary for the training and education of junior officers and men in the general service of the fleet, in all classes of ships and with all kinds of machinery.

C. Providing, in the cases of ships paying off and recommissioning abroad, for the spells of home service necessary for the health and recreation of officers and men who have completed their term of foreign service.

D. Providing for the application of the scheme to ships paying off on the home stations, and recommissioning after an interval, during which the vessels would be refitted and passed into the fleet reserve.

N.B.—This is the most difficult case to deal with.

In the consideration and discussion of this subject, we must not forget what a modern ship of war is like, as a whole, and as to the very numerous parts which make up this whole. And we cannot do better than to take the case of one of our largest battle-ships, already referred to in this paper, for purpose of illustration. Now this ship is *mastless*, *i.e.*, it is wholly dependent on the steam service for its efficiency as a portable floating battery. But the efficiency of the steam service of the ship depends on the competence of the mechanical staff, and this competence can best be acquired by actual service in the ship, which alone can give that thorough knowledge of the vessel in all its detail which, it is contended, is absolutely necessary. On this mechanical staff devolves—to use the words of an eminent authority, the head of one of the greatest engine-building firms in the world[1]—"the duty of keeping in order and knowing all about the main propelling engines, the *seventy-eight* other engines, and all the *vast* and *complicated mechanical appliances* throughout the vessel."

These statements are more matters of fact than of opinion, and must be thoughtfully and seriously considered in any discussion of this most important subject.

In conclusion, if the effective service of every modern ship of war depends on the competence of the departmental complements to utilize and develop all its power and capabilities; and if the competence of the mechanical complements depends upon, and is made more perfect by, actual service in the ship, it follows that the successful operation of any plan which secures the continuity of the effective service of modern ships of war must be of very great benefit to the general service of the fleet.

This continuity is secured by the plan proposed in this paper; for its aim is the *prevention* of the *entire dispersal* of the mechanical complements of war-ships at any time during the whole of their active life in the navy.

Captain CURTIS: I will say one or two words to start the discussion. The longer a ship is in commission, generally speaking, the more effective she gets, in consequence of her crew understanding her, and understanding one another, and the discipline generally is improved. The lecturer proposes to retain so many of these artificers, and, consequently, the ship in the engineers' room would be more effective. I think such a scheme as this, worked out on the Pacific station, would be most popular: you will get the men to reside in Victoria or Esquimalt, as that station is much liked. A spell might be given to some of these artificers to work in the dockyards at Esquimalt. Recently there have been two ships on shore on

[1] Mr. John Penn, M.P. for Lewisham.

that station, and the authorities have had to send artificers from England to repair those ships at great expense. I think some such scheme as this would work well in the Pacific.[1]

Mr. JOHN PENN, M.P.: I do not know whether I am in absolute order in addressing this meeting. I am only very glad indeed that this paper has been read, and that some attention is being drawn to this most important question. It would be, I think, altogether presumptuous in me if I were to criticise the possibility of carrying out such a scheme; that, I think, must rest entirely with the authorities at the Admiralty; but of the value of the scheme I am altogether absolutely convinced. It has always been a great wonder to me how these ships, on first being commissioned, with a lot of men pitchforked, haphazard, into them, have been able to run so well in the very earliest days of their commission. I think that this reflects the highest possible credit upon the engineers in charge of the machinery. But if this scheme were carried out, I am perfectly certain that these large difficulties, which they must feel and must experience, would be very largely overcome. There is a point in Mr. Williams's paper which appears to me to be of the highest possible value. He draws attention to the fact that, if engineers' artificers were to receive instruction, and to have the experience he advocates, they would be more useful men even than they are at this present time in carrying out those repairs which are absolutely necessary and absolutely inevitable in these days of complicated machinery. I do not think the powers that be quite recognise the enormous difficulty that will inevitably come about when these vessels in the Royal Navy are called upon, in time of war, to do their best. It seems to me that the running for so short a time at anything like full power—I believe it is only four-fifths of the natural draught power—for about four hours every three months does not test in a sufficient degree, not the engines or boilers, because they are tested on trial, but it does not test the mechanical staff sufficiently, and I feel certain if that trial were made longer and made more frequent, the mechanical staff at present existing in the ships would be found altogether insufficient to carry out their work. I do not suppose this is the proper place or occasion to touch upon that, to my mind, most serious step, the reduction in the mechanical staff of the ships. I would only touch upon the question raised by Mr. Williams, that these men, if they have the proper training, will be enabled to carry out the repairs to the ships and prevent those ships returning to the dockyard at short intervals. I think we have been so long at peace that we scarcely recognise the enormous difficulty that must occur to vessels in time of war. The naval manœuvres have thrown a considerable amount of light upon it. I only wish the Admiralty would direct, in these naval manœuvres, that "full speed" should be frequently imperative, that ships should not be allowed to run at easy-going rates, but should be forced to do their best. I only desire this, so that the weak places should be found, and that people should not be in a fool's paradise as to the condition of things below, for I am certain that, if the vessels were to run at full speed, the breakdowns would be very frequent, not from want of skill on the part of the men, but simply because there are not enough men to carry out the work. I only wish to say, if I may be permitted to do so, as an absolute civilian, but one who is really interested beyond anything in this question of the navy, that I view with the greatest possible satisfaction the suggestion of Mr. Williams, and I feel certain that, if it could be carried out, it would tend largely to the efficiency and usefulness of the ships in the Service.

Captain H.S.H. Prince LOUIS OF BATTENBERG: This strikes me as being one of the soundest proposals ever put forward here. It is distinctly based on common sense, and, as far as I am able to judge, there can be no difficulties whatever. As the lecturer very clearly points out, it refers chiefly to those stations where there are constant means of keeping up the supply of reliefs. There may be administrative reasons

[1] In the near future it will be necessary to have a staff of engineers and artificers at Esquimalt; some plan could be arranged for them to take their turn afloat, being relieved by men who have been two years afloat; the climate is good, and invalids could be treated at the hospital, Victoria. Possibly, before long, a reserve of small vessels may be kept at Esquimalt.—J. D. C.

against it, but I confess I cannot see them. At the same time, there are one or two points which strike me. One is that, as a matter of fact, although, as the lecturer says, theoretically, at the end of the commission the whole of the crew are cleared out, in practice that is not the case. (I am now speaking from my personal experience of the Mediterranean during the last half-dozen years, where I served as second in command of a big ship and as captain of a cruiser.) I think that, in every case of ships recommissioning, somewhere about one-third of all ratings, officers included, on paying off were appointed to the new commission. The result is that you have a certain number of people in the engine-room who have been in the ship before. It clearly would be much better to have it on a regular system, because it might be that, instead of having three or four engine-room artificers, you might have none at all if they were invalided or had served the full term. The thing rests now simply on the ordinary waste of a ship's company, and is a haphazard arrangement. That the Admiralty recognise the importance of some such scheme is proved by the fact that in all cases of which I have had personal knowledge in the last few years the senior engineer, or sometimes the chief engineer, was, on paying off and re-commissioning, ordered to remain behind for four or six weeks to show the new people round. This, I know, was a great comfort to the chief engineer and his people, but it was not particularly appreciated by those who had to remain behind instead of accompanying their messmates home: whereas, by what the lecturer proposes here, viz., changing the senior engineer in the middle of the commission, the same result would be brought about naturally. I confess I see a little difficulty in the scheme as regards ships at home refitting; in fact, I do not quite see how it is to be done. On the other hand, I think the lecturer rather ignores what is already being done by the new system with fleet and dockyard reserves. As a matter of fact, the ships in the fleet reserve have what is called "care and maintenance" parties; these not only comprise permanent engineer officers, but also a considerable number of mechanical ratings who are actually in the ship all the time. They go, I presume, on a sort of roster for foreign service, but, as a matter of fact, they do not all leave the ship at the same moment, so that it is not quite accurate to say (I am speaking of what has really happened within the last year) that if a ship is commissioned for sea to-morrow morning, every one on board would be new to her. She would naturally be commissioned from the A Division, Fleet Reserve, and the captain going on board would not only find there the navigating officer and chief engineer, but also the warrant officers and a considerable number of all ratings, engine-room ratings included—people who would know their way about the ship. That, however, does not in any way detract from the fact that this is a most excellent suggestion. I, as an officer who may be called upon to command a ship at any time now, would be delighted to see it done, and, although there may be people who would bring forward the objection which the lecturer has stated, that is to say, they would object to having so many of their men taken away at the end of every year, I do not think this ought to stand in the way for one moment. In fact, the case is so clearly put by Mr. Williams, and the advantage is so great, that I cannot understand anybody objecting to it, be he captain or chief engineer.

Vice-Admiral P. H. Colomb: If I had risen before I should have risen to draw attention to the same point that Prince Louis has drawn attention to. What was striking me was similar to what was striking His Serene Highness, namely, that the lecturer only proposes to extend and systematize what is really going on at the present moment. Whenever a ship is ordered to be paid off abroad, you find so many names starred as of those who are not going to be sent home, who are going to remain in the ship. That is, of course, not confined to engineer officers, but extends to all classes. Take the "Goldfinch," which is paid off and recommissioned abroad; in that case you find an officer who was appointed on November 5, 1891, who is starred and will remain till the next commission, and so it is throughout. They are always now in the habit, in paying ships off abroad, and even at home, of continuing a number of officers of all ranks in the commission. It does not seem to me at all difficult to accept the position laid down by the lecturer, and to extend and improve that system. But then at the same time what was striking me is, does not that apply to the whole system of paying off ships? Nowadays when ships are paid off abroad, is not the paying off a more or less formal business

more a matter for the accountant and the ship's books than for the people themselves? Inasmuch as all those who have only served a short time in the ship go on in her under the new commission, is it not practicable that if a plan of this sort were adopted, it might well be extended all round, and you might get rid of the complications of paying off and recommissioning, and might simply relieve officers and men on board ships which are to be kept abroad after a reasonable period of service? The writer of a pamphlet on "Justice to Naval Officers" claims that one of the great grievances is the long time that ships are kept in commission abroad. If this plan were adopted, that grievance would pass away; although ships might be kept in commission as long as they choose abroad, everybody would have his turn of the service, and come home. As regards the ships passing after a time into the Reserve at home, I agree with His Serene Highness that there would be great difficulty there, unless you went to very considerable expense; and then, again, I think, at the present moment—at any rate it was so in my time—everything we can do in the way of repairs, everything the mechanical staff of the Reserve can do, it undertakes to do. It was a point of honour with us not to let the dockyard in if we could help it. I think it is almost unnecessary to draw attention to that point, because I hope the practice still exists, that the engine-room artificers and the stoker mechanics are fully employed now in the Reserves in making all those repairs which would otherwise be made by the dockyard; but I agree that there is a great deal of right good common sense and moderation in the paper, and I think it is sure to have its effect when circulated through the Service.

Admiral Boys: I feel that I am now out of date on most naval questions, but, at the same time, the principle advocated in this paper is a matter, as His Serene Highness said, of common sense. I entirely agree with the principle; as to the details, others can carry them out. There is one observation I was going to make with regard to the point that has been raised as to the full speed capabilities of Her Majesty's ships. It is in my recollection that when the question of forced draught was first entertained in Her Majesty's ships it was with the view that they should be able to make extreme efforts of speed in action, either to rush to the relief of a friend, or to chase or escape from an enemy. Full speed and forced draught speed are not in the same category, and the forced draught speed of Her Majesty's ships is not to be compared with the continuous full speed of our grand mercantile liners that are now racing all over the ocean. Forced draught is an exceptional thing altogether. It is, in my view, something analogous to the case of the prize fighter, who uses the greatest exertion and endurance for a very limited time only, and then the business is over until another occasion arises. I should not like it to go forth from this theatre that Her Majesty's ships are unable to go at full speed for any amount of time. It happened to be my duty, some years ago, with the "Warrior" and the "Black Prince," and one or two other ships, to tow the Bermuda Dock across the Atlantic. We were under steam in the "Warrior" for twenty-five days continuously, and only stopped on one or two occasions for some slight adjustment of the engines; the efficiency of the ship depends on the efficiency of the engine-room staff.

Mr. Penn: I may say, in explanation, that I do not in the least degree confuse full speed with forced draught. What I advocated was full speed, as it is called, four-fifths of the natural draught. That is called the full speed under which the ships are to run for four hours once in three months—four-fifths of the natural draught power. I would not advocate forced draught: I do not like it.

Commander Wells: There are one or two points which have struck me in this paper as worth noting. I do not understand Mr. Williams or Mr. Penn to advocate familiarity with the mechanical work of the ship when the ship is lying idle; the whole force of the paper is familiarity with those departments whilst the engines are in motion. That can only be while a ship is under the pennant. It seems to me that in the Steam Reserve there are practically 33 per cent. kept on board; and that is a very useful measure; but they fail in familiarity with the engines while working. As regards the scheme quoted by Mr. Williams, looking at it from an economical point of view, you ring the changes every year on 33 per cent. each year of commission, which means that you have 38 men travelling out and 18 men

travelling home; and, taking a very liberal view from Mr. Williams's point, consider, for instance, Malta; that is a journey not accomplished under 10 days, it may be 12; therefore you lose the services of 16 men from one ship in a year for 12 days. That is, presuming that they can do a day's work on the day before they leave and on the day after they arrive, which fact, when multiplied into the requirements of a fleet, means the loss of a great deal of labour. If, supplementing this scheme of Mr. Williams's, we had depôts not only at home but abroad: for instance, if we had a depôt of mechanical ratings at Malta, then the give and take of the Mediterranean squadron would be from that Mediterranean depôt, which would be much more easily accomplished than from any depôt for the fleet at home. I am sure that this idea would appeal to the officer who spoke of the Pacific station. I think it will come to this, that we shall have depôts of these ratings, because in the Steam Reserve the men are working while the engines are lying idle, and therefore, perhaps, working at a disadvantage.

Captain G. F. K. HALL: I am sorry to say I did not read the paper before I came here. I think the scheme is a most admirable one. My only objection to it is, that I should not like to lose one-third of my complement. I confess, as a captain, I should not like it, and I do not think that the advantages of changing the men outweigh the disadvantages. I would ask Mr. Williams to take a smaller percentage. I think the principle is very good; but I am not sure whether a smaller percentage would not be better.

Admiral Sir F. DOWELL: I think the paper is an excellent one; I should like to see Mr. Williams's suggestions applied to the whole ship's companies. The difficulty will be the number of men who are invalided on tropical stations, and those not always the men who have been longest on the station.

Captain HALL: I did not mention invaliding. Of course, if the invaliding was taken into account, your real percentage of change would be over 33 per cent. A great number of men are invalided in the Mediterranean. You very often lose an artificer from invaliding, and the percentage would really come to over 33 if he were counted in.

Admiral COLOMB: He is counted in, no doubt.

The CHAIRMAN (Sir George Willes): As Mr. Williams is not present, I may say that he is a most intelligent, high-minded, and efficient officer. He has done very good work in the Service. He served under my command, also under Sir William Dowell, and I am sure we equally appreciated him. Since he retired from the Service, Mr. Williams has written in several of the reviews on subjects connected with the engine-room department, notably the boilers, and nothing could be more valuable. I am sure you will all consider it a great merit for him to have so well condensed his remarks, making his paper so short. It was written by a man who has given attention to the subject, and who understands the difficulty that the navy labours under with regard to the engine-room complement and management of the engines and boilers. Take, for instance, the large liners: the P. and O. steamers, for example, run from the London Docks, after a thorough refitting, at full speed to Australia and China, and back again, when they are again taken in hand, and put thoroughly to rights. Their engineers and staffs—the European staff at least—remain in them for 8 to 10 years. It is, no doubt, a very great advantage to run at a uniform speed. On the other hand, our ships of war are at a very great disadvantage. A ship, perhaps, is three months in harbour; steam is got up, and she proceeds to sea, running scarcely ever at a uniform speed when sailing in line. The frequent alterations in speed are detrimental to both engines and boilers. Therefore, if the P. and O. and other large companies have their engine-room staffs in them for long periods, the navy still more ought to follow the same practice; but it is impossible, for reasons Mr. Williams points out, namely, that it is necessary to give all the officers and men a fair turn of foreign service, and I do not know any other way of arranging it than the method proposed by Mr. Williams. I can assure Mr. Penn that there has not been a case in the last 10 years in which ships have gone to sea in the haphazard way he describes. The "Hood," for instance, is about to be commissioned. I feel confident that there are at least three engineers and three or four engine-room artificers who have seen that ship's engines put together, and, as His Serene Highness points out, at Malta, where they are con-

stantly recommissioning ships, they purposely leave a proper proportion of the engine-room complement. I really think we have improved in that sense, and if the officers in the navy generally would take a large view of this important subject, I really think that the proposal contained in this paper might be carried out with great benefit to the public service; and I think we are much indebted to Mr. Williams for having written it.

Note by the Lecturer.—Mr. Penn, in his remarks, touched incidentally on the recent reduction of the mechanical complements of our war-ships. Most experienced men consider this an unwise step to take. As to this, and its bearing on the subject matter of the lecture, it may be remarked that the assumed mechanical complement of the battle-ship is a *minimum* complement, viz., 27. A much more efficient complement would be 36, the nine additional being all qualified mechanics, made up of three assistant engineers and six engine-room artificers. A maximum complement of 36 in a battle-ship, exclusive of the chief and senior engineers, might keep the machinery thoroughly efficient, and would render it unnecessary to have costly repairs done at intervals by dockyards. Thus the expense incurred by the increased complement would be more than met by the saving of the cost of repairs by dockyards, and the ships would be permanently benefited by the stronger mechanical staff.

H.S.H. Prince Louis of Battenberg remarked that there were two points that required some explanation. 1st. "The lecturer says that, theoretically, at the end of a commission the whole of the crew are cleared out; in practice this is not the case," therefore "you have a certain number of people in the engine-room who have been in the ship before." But the Prince admits that the number so retained is small, and the plan a haphazard one. In the lecture I state distinctly that in ships paying off abroad there may be some attempt to retain a few men who have previously served in the ships, but this must be on a very small scale, and on no well defined principle or definite plan. Thus it will be seen that our statements on this point are almost identical. 2nd. As to ships refitted and commissioned on the home stations. "The lecturer rather ignores what is already done by the new system with fleet and dockyard reserves," which makes it "not quite accurate to say, that if a ship is commissioned every one on board would be new to her." The lecturer did not quite say this: what he did say was that at present "in every ship commissioning on the home stations there is probably not a single member of the mechanical staff who has served in the vessel during any previous commission." The point is well met by Commander Wells, who said he did not understand Mr. Williams or Mr. Penn to advocate familiarity with the mechanical work of the ship *while she is lying idle*, but rather the acquisition of that knowledge of the mechanical appliances which can be best gained in actual service while under the pennant. It was well said by Commander Wells that "the whole force of the paper" bears on this point.

As to the skeleton crews on board ships in the A Division of the Fleet Reserve, referred to by His Serene Highness. In these ships the machinery is in good order, having been thoroughly repaired by the dockyard staff. The "care and maintenance" party—the mechanic part of the skeleton crew—have simply to keep it in good order. Now these vessels, while in the Reserve, are under steam for only a few hours once or twice a year; no defects can well be caused by this, and therefore there can be no improving repairing work to do. Moreover, the experience gained by working the engines for a few hours a year cannot be worth much. What the lecture advocates is, that a considerable fraction of the mechanical staff who will serve in her when commissioned shall be employed in assisting in doing the machinery repairs of every ship while being brought forward for service. As has been said, the men would have a great personal interest in the work being well done, and the work itself would much increase the ability of our fleet mechanics.

Admiral Colomb also speaks to the same effect, and remarks that the mechanic ratings of the Reserve are now employed as far as possible in making good machinery defects. As to this, when provision has been made for the care and maintenance parties in the A Division ships, and for the numerous duties in connection with the Steam Reserve, other than making good defects, it will probably

be found that very few fleet mechanics are available for repairs of machinery, and it is obvious that these few men can be employed only on small defects of minor importance. There can be little doubt that, in order that fleet mechanics might take a more considerable share than at present in the larger and more important machinery repairs, the Steam Reserve would have to be expanded somewhat in the manner suggested in the lecture.

Commander Wells' suggestion as to the establishment of depôts for fleet mechanics on foreign stations seems to contain the germ of a plan which, if worked out and adopted, would much facilitate the annual changes in commissioned ships.

As to Captain Hall's remarks. He wishes for a smaller percentage of change annually than 33 of the mechanical staff; and, if it be considered necessary, it might be adopted without affecting the principle of the scheme; but Captain Hall will remember that two conditions had to be complied with in formulating the plan.

1. That during successive commissions of a ship there shall be, at all times, 66 per cent. of the mechanical staff on board who will have had from one to two years' service in her.

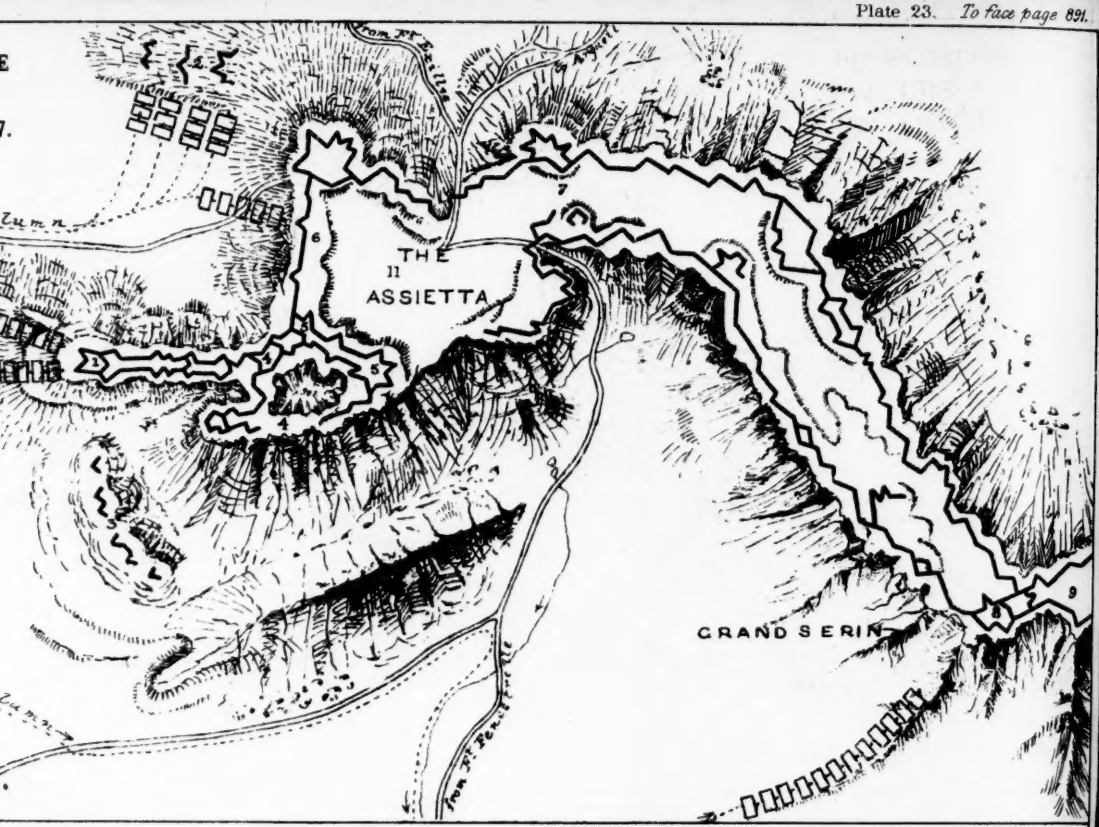
2. That at the end of every commission of three years all the members of the mechanical staff in her at the beginning of the commission shall have been removed into other ships to gain experience in the general service of the fleet. It is not easy to see how these two conditions can be complied with if the 33 percentage of annual change be reduced. Perhaps the adoption of Admiral Colomb's plan as to the *paying off of ships might make it possible to reduce this percentage, but it will* probably involve for every man a longer period of service in one ship than three years, which is the limit laid down in the scheme.

Admiral Sir William Dowell remarked on the way the cases of invaliding would affect the scheme. I take it that there is, on an average, a certain number of every ship's crew who are non-effectives through sickness and invaliding. *It should not* be difficult to ascertain what, under general circumstances, is this average percentage of loss from the strength of a ship, and it seems to be reasonable that there *shall always be a complement sufficient for the service of the ship*, exclusive of these non-effectives. It must be remembered that numerically, in proportion to the whole crew, the mechanical staff is small. In a battle-ship the proportion is nearly as 1 to 30; therefore the invaliding of one mechanic would represent the invaliding of 30 of the whole crew. Admiral Dowell advocates the extension of the plan so as to include the whole crew, and this no doubt would *make it necessary to* specially consider the difficulties connected with invaliding so large a number. With so small a number of mechanics to deal with, it is not considered that any *difficulties* can well arise that would render the scheme of annual changes unworkable, or that would be beyond the power of the local officials to deal with. Admiral Boys well said that the efficiency of the ships depends on the efficiency of the engine-room staff. Now the pith and marrow of that staff is the mechanical part of it, which should be thoroughly efficient, both as to number and quality. And *surely it is evident that this mechanical complement, on which the effective service* of all ships of war so much depends, should be assigned, not only with a view to meeting the bare requirements, but to providing such a reasonable margin of strength as would prevent the steam service being injured by occasional cases of sickness or invaliding.

In the carrying out of any system which has for its object the general good of the service there will always be exceptional cases which will require special treatment, and one of these cases will be the excessive weakening of a ship's crew, due *to an extraordinary number of cases of invaliding.*

My acknowledgments are due to the speakers who took part in the foregoing discussion for the impartial, judicious, and kindly criticism to which they have subjected my paper.—H. W.


SKETCH MAP
OF THE
ITALIAN THEATRE OF WAR,
1747.
Roads.
Bridle paths
BATTLE OF THE
ASSIETTA,
19th JULY, 1747.
de Mailly's Colum
d'Arnaudin's Colum
de Villemur's Colum
Aosta
R. Dora Baltea
R. Orco
R. Dora Riparia
TURIN
Assietta
Mt. Genevre
Briancon
Coni
R. Stura
R. Var
NICE
Ventimiglia
Riviera
DAUPHINE
PIEDMONT
PROVENCE
Alps
GULF OF
GENOA
Scale 24 Miles to 1 Inch.
Miles



Scale 6 Inches to 1 Mile (1/10560)

Yds. 100 0 100 200 300 400 500 600 700 800 900 1000 Yds.

Miles

Explanation

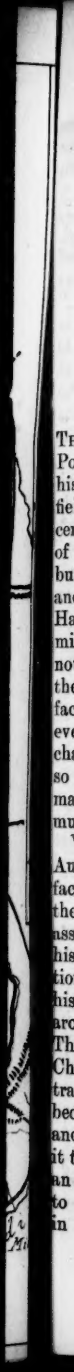
1. The Sardinian Guard 2, 3. Advanced Works occupied by Volunteers.

4. Forgaz (Austrian) Battalion 5. Traun (Austrian) Battalion 6 Meyer (Swiss) Battalion
7. Higginbach (Austrian) Battalion 8. Kalbermatten and Roy (Swiss) Battalions
9. Waldensians (Vaudois) 10. Local levies. 11. Reserve:- Casale (Sardinian) and Colloredo (Austrian) Battalions.

The original (reproduced by Dabormida) is a contemporary plan among the Royal Archives at Turin.

J. E. Clayson
Lieutenant R.E.

RISON & SONS, LITH. ST MARTINS LANE W.C.



OCCASIONAL PAPER.

AN XVIIIth CENTURY THERMOPYLÆ.

By Lieutenant J. E. Clauson, R.E.

The war of the Pragmatic Sanction was, so far as the contending Powers were concerned, one of the most barren struggles recorded in history. Nor, on the whole, does its study present a very profitable field to a modern reader. The present paper, however, deals with certain episodes which took place in the year 1747. The operations of that summer in Italy were thrown into the shade by the brilliant but inconclusive generalship of Marshal Saxe in the Low Countries, and by the great naval victories of Anson off Cape Finisterre and of Hawke in the Bay of Biscay. I hope, however, to show that the military passages which occurred in the less important theatre are not lacking in interest. They not only throw a strong side light on the course of a possible future campaign, but also illustrate certain factors which enter into all the problems of war, and recur anew in every military operation—factors whose origin lies rather in the character of the leaders than in the quality of the led, and which are so far independent of modern changes in the art of war, that one may fairly apply to them the old dictum, "Cœlum non animum mutant."

Without going into the complicated history of the great war of the Austrian Succession, it is sufficient at present to recall the following facts:—The Emperor Charles VI died in 1740 (which was, by the way, the year of the accession of Frederick the Great), in the comfortable assurance that the order of succession which he had established in his lifetime, and which had been guaranteed as the Pragmatic Sanction by the great Powers, would escape question after his death. But his anticipation was falsified by the event, and the war or wars which arose in consequence of the unforeseen ability of his daughter Maria Theresa to fight for her own hand, lasted until the Peace of Aix-la-Chapelle in 1748, "upon which," as Carlyle says, "except to remark, transiently, how inconclusive a conclusion it was, mere end of war because your powder is run out, mere truce till you gather breath and gunpowder again, we will spend no word in this place." Suffice it to say, that an "Aide-de-camp-général dans l'armée d'Espagne," in an account of the war published by him at Berne in 1784, attributes to this peace the origin of the Anglo-French war which broke out in 1756, and of the Austro-Prussian war of the same year; and then

goes on to declare that the subsidies disbursed by England in all these struggles had so impoverished her that she was compelled to tax American tea, and so brought on herself the war of American Independence!

Two valuable works, bearing on the campaign in Italy of 1747, have recently appeared in the two countries chiefly concerned. Colonel Dabormida, of the Italian Headquarters Staff, who is one of the first authorities on the north-western frontier in the Alps, has lately republished a monograph, entitled "La Battaglia dell' Assietta," which is valuable not only on account of the high critical power displayed therein, but also because the author had access to documents preserved in the archives at Turin of altogether exceptional interest —as, for example, the papers which were found on the bodies of the French Commander and other officers of high rank who fell in the action, which papers gave, in minute detail, the dispositions of the French Generals.

The other work alluded to is one which has already attracted much attention in the "Revue des Deux Mondes," and which the Duc de Broglie is now passing through the press in book form. This brilliant series of articles, under the title of "Études Diplomatiques," has thrown a new light on the history of the last century. As regards the campaign, the two works dovetail into one another in a very perfect manner, and as the former naturally relates, in much detail, the relations between the Piedmontese and Austrian allies, so the latter is of great interest on the subject of the want of harmony between the French and Spanish commanders. Generally speaking, the value of any campaign as a matter for study appears to vary in direct ratio with the number of parties engaged therein. There will be then the more accounts to collate and countercheck, while the various phases are thrown into vivid relief in the course of correspondence and negotiations between allies. Moreover, the influence on the conduct of a campaign due to the mutual relations between the allies is so often exerted on account of reasons other than military, that valuable experience of these complex factors of war can be obtained only from the study of such joint operations as those of 1747 in Western Italy.

Here the Marshal de Belle-Isle and the Marquis de Las Minas commanded the Franco-Spanish forces, while Count von Schulenburg, with a strong force of Austrians and Piedmontese, besieged Genoa, with the help of the British fleet. The successful rising of the Genoese Republic, mortifying as it was to the Austrians, after its humiliating submission to them in the preceding year, is the key to the whole situation. Their resentment against the victorious burgesses was intense, and, even to less prejudiced eyes than those of the ejected Imperial troops, the resistance of the Genoese citizens to the tyrannous rule of the Marquis von Botta seemed in those pre-Revolution days contrary to the fitness of things, and a precedent to be nipped in the bud. If the Austrians had failed to comply with the first part of the great imperial motto, "Parcere subjectis et debellare superbos," they were at all events resolved to carry out its second, and their garri-

sons in Italy were reduced to the lowest possible establishments, in order to aid the concentration in Liguria.

At the same time, the claims of the Genoese to assistance from France and Spain were fully realized in those countries, the more so from the fact that the fall of Genoa in the preceding year, directly due to the allied retreat, had inflicted a severe blow on their prestige. In order to prevent a repetition of this disaster, great preparations had been made to throw a mixed force of 12,000 men into the town, under the command of the Duc de Boufflers. Of the French battalions, half only reached Genoa, the fleet conveying the remainder having been intercepted by the British blockading squadron. The Spanish battalions were to have been drawn from Naples, but were not forthcoming, and, consequently, the reinforcement consisted only of between 2,000 and 3,000 French troops—a force very disproportionate with the rank of their leader Boufflers. The latter, as in duty bound, endeavoured to cover his poverty in men by wealth of brave words in the Genoese senate-house, but, at the same time, pointed out very emphatically in his despatches to the French Foreign Office the imperious necessity for prompt succour to avert the impending catastrophe.

Now, on the French side of the frontier were massed considerable Franco-Spanish forces. The French had 102 battalions and 73 squadrons (exclusive of garrisons in Provence and Dauphiné), and the Spanish contingent, though somewhat less strong, swelled the numbers to a formidable total. This army of Italy was nominally under the Infante Don Philip, but, as a matter of fact, under the dual command of Belle-Isle for France, and Las Minas for Spain. The Infante might have been non-existent for all the influence he exercised on these two headstrong generals; in fact, his dilettante demeanour was well suggested in Belle-Isle's nickname for him of "L'Enfant Voyageur." The evils of the division of authority soon showed themselves. One of the earliest causes of difference between the commanders was the lukewarmness of Las Minas with regard to the delay of the Spanish contingent for Genoa. But the great dissension, which had the most far-reaching effects on the course of the campaign, was on a question of strategy.

The general situation at the opening of the campaign was altogether in favour of the Western Powers. They had the advantage of the initiative and a great preponderance in numbers. Moreover, Genoa gave them a foothold in Italy, and a valuable strategic pivot, while also serving to occupy the attention of the Austrian commander, who would be as loth to raise the siege and turn towards the Var as was Melas in the opening of the campaign which led to the battle of Marengo—a campaign which may have been in some degree suggested by that now under examination. The objective both of Belle-Isle and of Las Minas was identical, viz., to relieve Genoa. But their plans differed widely, so much so that the matter had to be referred for decision to their respective Governments.

The Marquis de Las Minas proposed to march eastward towards Genoa along the Riviera, and, after compelling the Austrians to raise the siege, to threaten Lombardy through the Bocchetta Pass. The

Marshal de Belle-Isle considered that to act thus would be to court disaster, and that a diversion against Turin from Dauphiné would free Genoa, without the necessity of advancing a man beyond Ventimiglia along the sea coast.

This part of the history of the campaign is of much interest, the more so that the two able writers already referred to differ in their opinions of the merits of the opposing plans. The Duc de Broglie, whose peculiar point of view is rather that of the diplomatist than that of the soldier, sides, as is not surprising, with his countryman. Colonel Dabormida, on the other hand, argues in favour of the Spanish plan with an impartiality that cannot but add weight to his conclusions. In the first place, there is the argument that the course advocated by Las Minas had actually succeeded when employed by Maillebois in the brilliant campaign of 1745, and was again to be crowned with success in the hands of Bonaparte in 1796, when his object was to separate the Piedmontese and Austrian forces. This tendency of the Austro-Sardinian army to split asunder did not escape the notice of Napoleon, while it seems not to have occurred to the mind of Belle-Isle, whose plan of aiming at Turin (and thus encouraging concentration) was altogether at variance with the policy of hiscountry, which was rather one of holding out a sop to the King of Sardinia, in order to secure his secession from the Austrian Alliance.

Belle-Isle objected to the southern route, arguing that nothing could exceed the rashness of marching 100,000 men into a narrow and difficult defile, between hostile mountaineers on one side and the British fleet on the other, and that in the face of a fairly strong army which might at any moment out-manœuvre them and cut their extended line of communications. This objection was, no doubt, sincere, but the Marshal was perhaps also actuated by the wish to give an opportunity of distinction to a favourite brother, whom he had selected for the command of the Turin expeditionary force. This brother, the Chevalier de Belle-Isle, had greatly distinguished himself under Marshal Saxe at the battle of Roucoux in the preceding year, and enjoyed a high reputation in the French army. Closely bound together by the ties of affection and long comradeship in arms, the two brothers doubtless saw in this enterprise the chance of another marshal's bâton in their family. There were already 30 French battalions in Dauphiné about Briançon, and a reinforcement of 20 more from the army of Italy should enable the Chevalier to take the offensive and overcome all resistance between the frontier and the King of Sardinia's capital.

But Las Minas was obdurate and refused to be convinced, so the issue had to be carried from the headquarters of the army of Italy to the council chambers of Louis XV and Ferdinand VI. The decision was against Belle-Isle's proposed diversion against Piedmont. The French King's letter to Belle-Isle admits the military soundness of the plan, but adds that more powerful considerations prevent him from adopting it, viz., "the endless self-reproach which would await me if the Republic of Genoa should fall, and should be able to

attribute her ruin to the want of the succour I might have brought her." The royal reasoning is somewhat inconclusive, for Belle-Isle's very point was that the direct road to Genoa so bristled with obstacles that the defence would fail before the relief could reach it, while his own plan would at once draw the enemy from Genoa in order to save Turin. The letters of the ministers on the subject, which attribute the adoption of Las Minas's plan to a desire to please the Spanish Court, are given at length by the Duc de Broglie, who certainly seems to produce overwhelming evidence that Belle-Isle was overruled for this reason alone. At the same time it is questionable whether the decision would have been different if taken on purely military grounds.

While the despatches were passing to and fro between the headquarters of the army of Italy and those of the French King and his Marshal-General in the northern theatre of war in Flanders, the concentration in the south was completed, and the Var reached on the 3rd of June, 1747. The Austro-Sardinian forces opposing the advance consisted of 17 Piedmontese battalions and 12 Austrian under the command of General Frederick Leutrum, one of the most distinguished of Sardinian leaders, whose name is to this day a household word in Piedmont. Leutrum had orders from Charles Emmanuel III to resist to the utmost, in order to cover von Schulenburg's redoubled efforts to reduce Genoa.

Meanwhile Belle-Isle's impatience was so great that he contrived to persuade Las Minas to consent to the transfer of 18 French and two Spanish battalions into Dauphiné pending the arrival of the decision of the Courts,—this on the ground that they would be required there if the decision should be in his own favour, and that, if otherwise, this force could act as a detached left wing to the southern line of advance. This was towards the end of June, and on the 7th of July the Chevalier de Belle-Isle left to take command of these and the other troops about Mont Dauphin. Thus the French Marshal for the moment gained his point, and it only remained to be seen whether the Chevalier could turn the occasion to account.

The north-western frontier of Italy can be divided very readily into four distinct sections of defence—the passes in the first converging on Aosta, those in the second on Turin, those in the third on Coni, while the fourth section constitutes the Ligurian Riviera. Of these sections the second and third were more immediately threatened by the French troops in Dauphiné, and, for several days prior to the arrival of the Chevalier de Belle-Isle, his second in command, d'Arnault, had been making demonstrations against what I have called the third section of defence with a view to inducing the Piedmontese to expect attack in that portion of their thinly garrisoned line. With the same object he had resorted to many other artifices, such as the establishment of bakeries at misleading points, and the employment of sham deserters to carry false reports into the enemy's lines. But the King of Sardinia was not deceived by these devices—partly because he had at his disposal a proverbially perfect intelligence department, and partly because he fully realized how

deadly a blow might be if aimed at his capital through the passes of the Mont Genèvre while the bulk of his forces was far away in Liguria.

He therefore proceeded to organize the defence as far as his resources permitted, but found that, after reducing garrisons of fortresses to a minimum, he could only dispose of 10 regular battalions and 30 squadrons. An immediate increase of this force was essential, but reinforcements could not be drawn from Leutrum's army without prejudicing his retarding action in the Riviera. The only alternative was to call on the Austrian Commander-in-Chief, Count Brown, to send any troops available at the time in Lombardy. His appeal, carried by his Secretary for War in person, brought him only four Austrian battalions and some few squadrons of cavalry; but, before their somewhat tardy arrival, the conviction had been forced upon the King's mind that it was impossible for him at this serious juncture to dispense with the troops he had with some reluctance lent the Austrians for the siege of Genoa. It had become evident that the siege must be abandoned, for, in view of the gathering forces across the frontier, he could no longer forego the aid of Leutrum, who was for the time being kept on the Cornice road by the necessity of covering the siege operations.

It seems probable that von Schulenburg held a similar opinion on this point, but he was well aware that the Court of Vienna attached more importance to the capture and humiliation of Genoa than to the safety of the King of Sardinia's dominions, and he consequently endeavoured to shield himself from responsibility by requesting Charles Emmanuel to give him a formal order to raise the siege. This the King declined to do, for the Viennese Court had already more than once refused to acknowledge his right to give orders to the Austrian army of occupation. On the 30th of June, however, he sent instructions to Count della Rocca, commanding the Piedmontese contingent before Genoa, to withdraw his 12 battalions and to join Leutrum.

This move necessarily involved the relinquishment of the siege by von Schulenburg, whose own forces were insufficient to continue it unaided. The object of the King was to that extent attained; but, owing to his inability to control the Austrian General's subsequent movements, one of the most promising situations in the campaign was rendered abortive. Colonel Dabormida points out in his essay the advantages that might have resulted if a counter-attack could have been delivered about the middle of July in the Riviera by the united forces of Leutrum and Schulenburg. At that time there were 40,000 Austro-Sardinian infantry in Liguria, besides militia, as against 30,000 Franco-Spanish, while about Mont Genèvre were 8,000 Austro-Sardinian regular troops against Belle-Isle's 20,000 Frenchmen.

Under the circumstances the King of Sardinia might have taken advantage of his preponderance in Liguria to force the invaders back beyond the Var. Meanwhile his right wing of 8,000 men in Piedmont, based on the forts of Exilles and Fenestrelle, would have had but little difficulty in retarding the Chevalier de Belle-Isle's advance,

until a sufficient force to crush him could be detached from the victorious left wing. But this plan could not be adopted, owing to the inaction of the Austrians, whose movements were probably much hampered by defective means of transport and victualling. It is possible, too, as Marshal de Belle-Isle supposed at the time, that the Austrian Commander-in-Chief had hesitated to act without referring the matter for the instructions of the Aulic Council at Vienna—a course of procedure open to many objections, but as common in the Austrian army in those days as it was at a later date.

The Marshal de Belle-Isle was naturally much elated at the news of the raising of the siege, which event he justly attributed to his own action. This feeling, however, was destined to be short-lived, for the despatches from Flanders arrived with the letters of the King and his ministers condemning the project of the march on Turin, and directing him to co-operate in the Spanish General's scheme. In the face of these positive orders there appeared to be no other alternative than to recall his brother from the enterprise upon which he had pinned such hopes. Yet, he considered, circumstances had altered since the letters had been written. The King expressly said that his decision was based solely on the expediency of furnishing early relief to Genoa, and that very relief had already resulted from a tentative recourse to the despised plan. Besides, the Austrian army was now no longer detained before Genoa, and would dispute the advance into Liguria much more formidably than Leutrum's smaller force, while the withdrawal of the French from Dauphiné would release as many Piedmontese. The Spanish General's scheme seemed more impracticable than ever.

These last considerations had some weight with Las Minas, who was much perplexed by the turn affairs had taken, and by the additional weight of responsibility devolving upon him. After three long days of hesitation and correspondence he admitted that it was too late to withdraw the Chevalier, while still declining to formally concur in his advance on Turin. This was sufficient for Belle-Isle, who ordered his brother to resume the temporarily suspended advance, and wrote to the King of France that all was proceeding in Italy in accordance with Marquis de Las Minas's wishes.

The three days' delay caused by the negotiations between the allied Generals was utilized to the full by the King of Sardinia, whose fears were intensified when he was informed of the arrival of the Marshal's brother in Dauphiné. His precautionary measures were, as has been already stated, chiefly directed to the roads converging on Turin along the valleys of the Dora Riparia and the Chisone. The spur of the Cottian Alps, which runs eastward separating those two valleys, is cut by several passes, chief among which is the Plateau-col of Assietta. This plateau was of vast importance to the defence owing to its command over the two defiles, which are connected by numerous bridle-paths affording good lateral communications, while the even slopes of the plateau present excellent defensive positions. After passing the Mont Genèvre, an invading army must necessarily advance by one or both of the two valleys, and in either case posses-

sion must first be obtained of the Assietta. The forts of Exilles and Fenestrelle, north and south of the Assietta, are well placed to resist attack, and constitute with it the chief defence of this part of the frontier. The Count di Bricherasio was entrusted with the command of the troops about to garrison the position; and a captain of engineers on his staff had elaborated a scheme of intrenchment well calculated to utilize to the full the natural advantages of the position. Unfortunately, the design was somewhat too ambitious in view of the limited means at the Count's disposal.

The plateau of Assietta is commanded by two bluffs, which rise from its western and eastern extremities, and which are respectively known as the Heights of Assietta and the Grand Serin. They are about a mile apart, connected with the plateau proper by gentle slopes. The general scheme of fortification was to form closed works on the summits of the three principal features, and then to connect the works by continuous lines of breastwork into one large intrenched camp. In addition to this, some light works open at the gorge were constructed on the approaches, with the object of inducing the French to develop their attack at an early stage. All the breastworks consisted of rough stone walls built without mortar, and averaging 4 ft. in height and 2 ft. 9 in. in thickness. The work on the Heights of Assietta, which would have to bear the first onset of the enemy, was, owing to the exigencies of the site, traced as a hornwork presenting a narrow head to the enemy, but admirably adapted for delivering a heavy fire to the flanks. It was intended to have a second tier of fire from a cavalier in this work, but this was not completed when the attack took place; indeed many portions of the lines were hardly more than traced out by that time.

On the morning of the 19th July, 1747, the Count di Bricherasio's outposts were driven in by the French, and the outlook seemed gloomy enough for the little Piedmontese force. The 10 battalions marching to their aid from the Riviera could not be expected for several days. Three other battalions from Coni and Turin, which had also been ordered by the King to join the Count, had not yet arrived. There was not a single available piece of artillery, and the defensive works were very far from completion. There were only nine Piedmontese and four Austrian battalions (in all scarcely 7,400 men) to man the weak and extended lines. Ammunition and stores of all kinds were very deficient. Yet, to have abandoned the plateau to the French would have led to the fall of Exilles and Fenestrelle, both of these forts being very short of supplies; and their fate would probably have involved that of the Sardinian capital. The Count therefore drew up his small force for action.

The defence of the hornwork was entrusted to the Sardinian Guards, whose ancient privilege it was to occupy the post of greatest danger in action. Four other battalions were detached to neighbouring heights to prevent the French from turning the position, and the remaining eight battalions were disposed along the breastworks in the most advantageous manner possible under the circumstances.

The French troops advanced to within a few hundred yards of the Piedmontese position, and there the Chevalier de Belle-Isle enacted the stately, if somewhat theatrical, ceremonial of which Napoleon's parade before Waterloo is the last and most memorable instance. In full view of the enemy the army was marshalled into three imposing columns of attack. Of these the right, under de Villemur, was the first to march off, and, leaving the Assietta on the left, made for the Grand Serin. This circuit necessitated a delay on the part of the centre and left columns, which were destined for the attack of the hornwork and of the plateau respectively. Seven guns were, meanwhile, brought into action on a knoll opposite the Heights of Assietta, and a brisk fire directed against the rubble breastworks. The Piedmontese were unable to make any reply, as the range of their muskets was less than 200 yards.

About 4.30 P.M. the Chevalier ordered an advance, for he estimated that by that time de Villemur would be ready to attack the Grand Serin. The left column, under de Mailly, moved forward through the scrub to scale the ascent to the plateau of Assietta, but was received with a withering fire, under the stress of which attack after attack broke fruitlessly. It succeeded in carrying some open works out of gunshot of the main line of defence, but that was all. Meanwhile d'Arnault's troops advanced with extraordinary dash against the hornwork. Two brigadier-generals led the van of their respective storming columns, the first ranks of which were entirely composed of officers. Ably led under cover of folds of the ground, the French were on the breastworks almost before a shot could be fired. But, in the face of the stubborn resistance of the Sardinian grenadiers, they found it impossible to penetrate into the lines, or even to accomplish their purpose of pulling down the parapets stone by stone.

The Chevalier stood on the knoll beside his guns, watching the progress of the fight with the deepest anxiety. He had written, a few hours before, to his brother that at last success had come within his reach: "Demain je mériterai comme vous le bâton de maréchal de France." Yet now his success was jeopardized by a handful of half-trained Italians. No longer able to bear the suspense, he rushed to the front on foot, and, seizing a standard, planted it with his own hands on a small breach in the parapet. Twice wounded within a few seconds by bullet and bayonet, he still refused to quit his perilous position until a second bullet killed him outright. Almost immediately afterwards d'Arnault fell at the same place, as did many other officers. The conflict raged with all the intensity that a hand-to-hand fight alone can assume. The little Piedmontese force held its ground with indomitable courage against the successive waves of fresh French troops. Their ammunition had failed, but they fought on with the bayonet, and even with stones taken from the parapet.

Meanwhile, behind them at the Grand Serin, the Marquis de Villemur was as unsuccessful in effecting a lodgment as the other French Generals. Belle-Isle had probably not expected to find this point fortified, and had anticipated an easy success for his right column, in which case the general position would have been com-

pletely turned. The Count di Bricherasio fully realized the importance of keeping the Grand Serin and, when the attack was delivered, proceeded there in person with reinforcements from his reserve. At this stage, however, his determination appears to have deserted him, for he sent orders to the Count di San Sebastiano, commanding the 1st battalion of the Guards, to abandon the Assietta and retreat on the Grand Serin. Fortunately for Piedmont, San Sebastiano, who was the son of the ex-King Amedeus III of Savoy by a second marriage, was a man cast in no common mould. There is no better description of the motives which led him into the independent course of action he adopted, than that given in the Memoirs of the Count de Malines, who knew him intimately:—

"Le comte de S. Sébastien se voyait dans un poste où de bons soldats faisant bien leur devoir seraient difficilement forcés, et il pouvait compter sur son régiment; il considérait aussi que la fortune de son pays tenait à se maintenir dans ce poste qui garantissait deux places importantes, et il voyait outre cela que, les ennemis étant déjà fort près de lui, il n'y avait de salut pour sa troupe qu'en se bien battant dans cet endroit, parceque la longue retraite à faire devant un ennemi de beaucoup supérieur était impossible; il répondit donc à son général que s'il eût été à sa place il eût sûrement jugé qu'il était possible de s'y défendre et impossible de s'en retirer."

The Sardinian commander was, however, not to be convinced, and despatched an aide-de-camp with a peremptory order, which seems to have been in writing at the request of San Sebastiano. But, by the time it reached the hornwork, there was no longer any possibility of drawing off the troops. For close on three hours the French masses had been surging up against the rubble breastwork, only to be beaten back, time after time, with enormous losses. The sun was getting low, and threatened the early approach of the short twilight which belongs to high altitudes. There was time only for one supreme effort to retrieve the fortunes of the day. The serried ranks pressed once more up the narrow slope, and dashed against the piles of stones which marked the line of the works, just as the Count di San Sebastiano received his chief's last message. The Guard, sorely tried by the stress of the long fight, looked to their Colonel, to the influence of whose brilliant personality the stubbornness of their defence had been so largely due. His choice was soon made. "In the presence of the enemy we cannot turn back," he exclaimed, and his words evoked the greatest enthusiasm from the devoted little garrison. For the last time the walls were manned, and, after a fierce struggle, the French, whose splendid qualities on the offensive were never more admirably or less usefully displayed, were hurled back once more in confusion, and drew sullenly off in closed masses as night fell over the field.

At the Grand Serin de Villemur's column was likewise repulsed with heavy loss, and in full retreat before dark. The advance of a few light troops would have converted the retreat into a rout, but the Count di Bricherasio declined to incur the risk; and three days later the French recrossed the frontier in the greatest possible state of dis-

organization. Their losses in the action amounted to 5,300 men and 430 officers, including 2 Generals, 5 Brigadiers and 9 Colonels. The Sardinians lost 185 men and 7 officers, while the Austrians lost 27 in all.

The battle of Assietta was the decisive blow in the campaign of Italy. There was but little subsequent fighting in the Riviera, and that of a very desultory character. The impression made by the disaster on the French Court and people was intense. The general feeling, as recorded by the Duc de Broglie, was that the reverses in Italy nullified the victories in Flanders. The flower of the French nobility had fallen among the officers killed in action at the Assietta, and few noble families were unrepresented in the long roll of losses. The number of officers killed and wounded was almost equal to that of the British at Waterloo. But while, in the latter case, the proportion of killed to wounded was less than one to four, at the Assietta, it was three to one. This fact shows very clearly the desperate nature of the fighting, as well as the effect that must have been produced on society in Paris by the battle. A French diplomatist wrote to the Marquis de Belle-Isle, that in Court circles it was commonly said that the defeat had disjointed the whole frame of French politics, and damaged French prestige in every capital of Europe.

From a military point of view the conduct of the Count di San Sebastiano is one of the most interesting episodes of the engagement. It is a nice question whether he did not exceed the limits of discretion permissible to a subordinate leader; but it must be admitted that a retreat from the heights of Assietta over the exposed slope leading down to the plateau would have, in all probability, led to the practical annihilation of his small force, besides possibly bringing confusion into the garrison of the Grand Serin. Be that as it may, San Sebastiano's name was altogether omitted in despatches, and although he was afterward decorated and granted a small pension as a recompense for his share in the battle, he soon fell into disfavour at Court on political grounds, was deprived of his command, and died in obscurity. The Count di Bricherasio, on the other hand, whose faint-heartedness had so much endangered the fortunes of Savoy, was raised to the highest honours at her disposal.

This was not, however, the verdict of contemporary Europe, which unanimously accorded the whole credit of the victory to the intrepid Commander of the Sardinian Guard.

Thirty years ago to the average inhabitant of Italy such episodes in her history were a dead letter. Patriotic writers looked instinctively to France for the ultimate rescue of their country. Everything which might ruffle French susceptibilities was gently glossed over. The treatment of the Venetian Republic by Bonaparte, the long list of deceptions and exactions practised by French Generals, the brutalities of the French soldiery, the massacres at Rome in 1849, the intrigues after 1859, all the events which might have afforded ample materials for a chronicle of "Gesta Diaboli per Francos," were veiled in discreet silence.

But in the general awakening to her glorious traditions which Italy

has experienced within the last few years, and for which she is indebted in so large a measure to her present King, these dark places have been thrown open. A new and brilliant generation of military writers, unhampered by political exigencies, has recorded for Italian soldiers the warlike exploits of their predecessors. The great interest with which accounts of this engagement have recently been received in Italy is, no doubt, due to the fact that the battle-field is now, as then, one of the most important key points of the Italian frontier. Under the patronage of King Humbert, the heights of Assietta have been crowned by a monument commemorative of their gallant defence on the 19th July, 1747. The brigade of the Grenadiers of Sardinia still exists in the Italian army, and by ancient privilege takes the right of the line. But if ever again it should unfortunately happen that the two gallant nations which crossed bayonets that day meet once more on the Cottian Alps, it is to her splendid Alpine troops that Italy will look to stem the torrent of invasion, while she is effecting the necessarily slow process of her mobilization in rear. She assigns to them the same task as that which their forefathers performed so well.

FOREIGN SECTION.

SUBMERGED DISCHARGE FOR WHITEHEAD TORPEDOES.

By Captain G. Astuto.

(Translated by permission from the "Rivista Marittima" for May, 1893, by T. J. Haddy, R.N.)

The "Mittheilungen" of Pola, vol. xx, No. XII, copied some remarks of the "Broad Arrow" on the large number of men employed at Portsmouth in the manufacture of submerged tubes for 18-in. torpedoes, and on the advisability or otherwise of supplying cruisers and small ships with torpedo discharges of any description, the "Mittheilungen" making the following observations on the subject: "As our readers are aware, a change of ideas is taking place in favour of submerged discharge, so that in France, where until now its very name inspired terror, it has been largely adopted for their first-class ironclads under construction. Italy first led the way, the stem of the "Duilio" having been designed to take a submerged torpedo-tube later, although she was launched at a time when torpedo discharge from a ship in motion was far from being perfect. The agreement of all nations in favour of the submerged system of discharge has its own particular justification, independently of the improved practice, at least in the line of keel, in the necessity which now exists to protect the torpedo from the effects of artillery, which lately has made considerable progress. The price indicated by the 'Broad Arrow' cannot be considered exorbitant, but the great weight of the English apparatus would be opposed to its employment in vessels of small tonnage." The author then proceeds: "The fragments which we have reproduced give information and express opinions; the latter rather than the former have attracted our attention. It was known from information contained in the various papers and technical reviews that for some time there has been a tendency in England towards making the employment of broadside submerged discharge general, and that the search after such an apparatus has long occupied the attention of that navy. From a spirit of imitation or conviction, or from the fascination which the unknown always awakens, it is not the English navy alone which has been desirous to equip its ships with the broadside submerged discharge. We can assert, however, as far as regards foreign navies, that the English alone possesses a discharging apparatus which is con-

sidered satisfactory; it is this type, produced probably by successive modifications of others previously experimented with, which has been fitted on board the 'Royal Sovereign,' and by means of which 18-in. torpedoes have been discharged in good condition with a speed of ship of nearly 18 knots." So much for the information contained in the notice of the "Mittheilungen;" as regards the opinions expressed, they do not appear to us to be either exact or practical.

Above all, submerged discharge in the line of keel, either "bow" or "stern" discharge, cannot be considered from the same point of view as a "broadside" submerged discharge. To discharge a torpedo in the direction of the ship's path would appear to be the most practical method, and was the first application of the weapon. It is said that the doubts which till lately have agitated some foreign navies on such a method of discharge have disappeared; it is not, however, quite true that they have completely, or that they have in one case and not in the other. It is a fact that the new ships are usually designed to receive a bow tube in the line of keel, but it is equally a fact that not a few officers ridicule the idea from the risk of the ship overrunning her own torpedo after discharge, which, through the failure of its engines, has neither got clear away nor gone to the bottom, or of ramming the enemy with a torpedo in the tube ready for launching. It is also considered that the stem is weakened by being arranged to receive a torpedo discharge, and that it would therefore be more injured by ramming. Now, that these objections have a certain value, we can admit; we should consider, however, that the torpedoes and the method of discharging them now give a complete guarantee of success, that we can have torpedoes which will at once dive to the bottom if not put in motion by their engines, that by launching the torpedo before ramming the risk of ramming with the charged torpedo in the tube is eliminated, that as regards the injury which may be caused by having rammed, the fact that the stem has been adapted to take a torpedo-tube is a quantity which may be neglected. There would not be a few cases, on the other hand, in which an unsuccessful attempt to ram might be compensated for by a torpedo discharge; the direct discharge from the bow does not necessitate any special manœuvring, and, whilst it can be used in almost every case in which a ship is being manœuvred with the object of ramming, it represents the employment of a weapon most disastrous in its effects, in the position almost always the most safe for the ship, that is, with her bow towards the enemy. So also by stern discharge in the direct line of the keel the ship herself runs no risk of injury, the method of discharge presents no practical difficulty, and gives rise to no inaccuracy in the path of the torpedo, whilst it would be of the greatest advantage in the event of the ship being attacked by ramming, and the attacking ship passing under her stern not having succeeded in the attempt. But if these considerations and the good result obtained by the new torpedo material may, and have, eliminated all the anxiety or, we may say, the terror which the submerged discharge from the bow and stern has awakened, the same could not be said of the submerged discharge from the broad-

side. The opinions on such a method of discharge in its technical aspect are directly antagonistic, but, before remarking on them, it will be well to mention some other points in the notice of the "Mittheilungen."

With respect to the arming of war-ships with the torpedo, it is said that cruisers and scouts should not be furnished with them, because such ships are not constructed to fight at close quarters. Is it not necessary here to enquire what should be the duty required of cruisers, and with regard to which their war armament should be rationally determined? It is well to note, too, that the name "cruiser" has such an elasticity of signification, and ships of such varied types and dimensions are so named, that it is not possible to consider all the so-called cruisers under the same category. From the "Blake," of 9,000 tons, to the "Pearl," of 2,525 tons, in the English navy, from the Russian "Rurik," of 10,925 tons, to the French "Cosmao," of 1,875 tons, we accept the classification of Bertin, so great and so numerous are the differences in their offensive and defensive power and autonomy, that one cannot understand how it can be asserted that cruisers in general are not designed to fight at close quarters, and therefore should not carry torpedoes. But a detailed examination of the argument cannot be entered into in a short notice; limiting ourselves, therefore, to a particular case, we will make a few observations. It is probable that, under the name of cruisers, allusion is made to the relatively small ships rather than to the others, and to which great damage would be caused by explosive projectiles from modern guns of moderate calibres. Now, as regards the gun armament, it may be maintained that in the majority of cases a ship can only compete with her equals, that is, with similar ships having displacements not differing very much from her own, for we may conclude that each navy will have utilized the displacement with that harmony of offensive and defensive qualities which would appear most suitable to such an end. The torpedo armament, on the contrary, makes all types of ships equal in view of an attack which is certainly a fatal one, with this reservation, however, that the ship of greater displacement, with a larger reserve of buoyancy due to her internal structure, and her more effective pumping arrangements, may find a palliative against material but not against military loss, and that the ship of small tonnage may find protection in her limited draught of water. This is not to say that a cruiser of this nature is a battle-ship in the true sense of the word, and we do not mean, therefore, to assign to her such a limited sphere of action as to the battle-ship; we use the terms rather unwillingly, as they are, in our opinion, not applicable to modern ships, but what we intend to arrive at is this: that if a cruiser of the weak type with which we are concerned has a torpedo equipment, she will be able to effectively annihilate the enemy's transports; in attacks by surprise and at night, which will form an important part of future naval war, she will be able, by means of the torpedo, to fight efficiently against heavier ships, and when in a supreme moment an opportunity is offered her of sinking an important ship of the enemy, it wil not be the fear of consequences to herself

which will prevent her making the attempt. Whatever the occasion, the meeting at close quarters will always favour the weaker ship, because she will in this way be exposed to the offensive powers of the stronger one for a very short time only, and for that time they will be equal at the single instant and at the single distance from each other which can be decisive, that is, at which the torpedo can be discharged. To say that such a ship ought not to carry Whitehead torpedoes because she is not expected to fight at close quarters does not, therefore, appear to us to be a wise conclusion. To say that she should at least be fitted with submerged, and not above-water, discharge, appears to us equally unwise, as for each of these ships it would be equivalent to saying that she should have no discharging tubes at all, because the substitution of submerged for above-water discharge does not appear to us advantageous, and here is the reason why. No naval officer is ignorant of the fact that the torpedoes do not require any corrections or special means of discharge from submerged tubes in the line of keel, either ahead or astern, and that, therefore, these give the most favourable conditions for launching them. The tubes in such cases are not excessively heavy and cumbersome, and if, with unreasonable anxiety, it may be thought possible for a ship to overrun her own torpedo, the advantage of having the tube protected is such as not to admit of a doubt in the choice between the above-water and submerged positions. It may be added that, whatever may be the velocity of the torpedo in its passage through the tube, the direction of discharge remains invariable, and as was determined for the favourable instant of launching; and, in the case of a bow tube, a delay in launching would not cause an appreciable error in the velocity of discharge as calculated for the favourable instant, for, within certain limits, the error that it is possible to commit in the latter case is very slight; lastly, the torpedo, when discharged right ahead or right astern, is not subjected to any force tending to deform it.

In the broadside submerged discharge, on the contrary, until it is quite free in the water the torpedo is subjected to a lateral pressure sufficient to deform it, however strongly it may be constructed, even at a moderate speed of the ship; and, inasmuch as it is necessary to guide the torpedo until it is quite clear of the ship, and as in this manner the lateral pressure exercises a tearing strain on the holding pieces, it is necessary to use a high pressure for the expulsion, in order to impart a high velocity of discharge to the torpedo and to overcome the friction of the holding pieces in the guide channels. The torpedo must therefore be strongly reinforced at the points where the holding pieces are applied, and the after body must be strengthened more than is necessary for the other methods of discharge. Besides, as it would not be convenient to have special torpedoes for each side of the ship, nor differences in form and weight of the torpedo with respect to its longitudinal plane, the holding pieces and their reinforcements must be fitted to both sides of it; this makes it heavier than the other torpedoes of equal displacement, with, consequently, less reserve of buoyancy, which is not

however a great evil, and also more cumbersome, which certainly is a defect.

The shield which serves as a guide for the torpedo, and which cannot be made less, must show no sign of flexure, even at the highest speed of the ship, and must be rigged out and in with safety and rapidity; it is therefore evident that the apparatus in these particulars must be solid and robust, and, to refer to the information given by the "Mittheilungen," a weight of 9 tons and a cost of 2,000*l.* to 3,000*l.* is attributed to the English apparatus. It is not necessary to demonstrate, and it is sufficient to remark on, the serious results which would occur if the torpedo, by reason of insufficient impulse or failure to start, or from damages received, should come into collision with the ship discharging it. We may nevertheless admit that every minute detail has been attentively studied, and all difficulties happily overcome, so that not a doubt remains as to the free exit of the torpedo, that the space occupied inside the ship is the smallest possible, and that the breadth of the ship need not be more than one and a half times the length of the torpedo; the first point ascertained would be, however, this: that by reason of the weight and inconvenience, it would not be possible on any type of ship to fit an equal number of submerged discharges to those of the above-water which they would replace; that on many ships the number would have to be limited to one each side, and on many others no room at all could be found for it. Allowing that the torpedo gets clear away from the ship, we have also to admit that it maintains the direction of discharge, or that the deviation is always of the same sign and value; if this is not the case the broadside submerged discharge, however admirable it may be mechanically, is not a weapon of war; it would be worse than useless, and in no sense justified in comparison with the above-water system. But, admitting that the torpedo maintains its direction of discharge, it is difficult to imagine a duplicate or training system; we do not give a very great importance to a wide range of fire in a horizontal direction, and we imagine the attack will be made with the direction of discharge of the torpedo predetermined, but it is, however, an advantage when in chase, just as it is an advantage to have at least two torpedo discharges on each side with torpedoes ready for launching simultaneously, to compensate for possible errors. Besides, for the lateral discharge we attach a special importance to discharge on the bow, or in chase, and as it is not possible to have the duplicate or branch system, so also it is impossible, or at least very difficult, to have the "in chase" system of discharge, because the practical solution of the difficulties for the broadside would not be the same as for the discharge on the bow. If therefore for the submerged discharge only that on the broadside is possible, and if it is equally impossible to have two at least on each broadside, its tactical inferiority with respect to the above-water discharge is evident. A submerged tube, however, is completely protected, and this, we understand, is the reason which has determined the adoption of the system; on this point we will refer to the excellent article of Chief Engineer R.

Bettini, published in the April number of this Journal, and admit "that the greater the proportion of the displacement which is assigned to this object of that which is available for protection, so much the worse are the consequences which result from any damage which this portion may receive, and so much greater is the probability that those injuries will prove fatal."

The protection of the torpedo-tubes has two objects in view, to avoid diminishing the offensive power of the ship, and to obviate the danger to which the ship might be exposed by the explosion of the guncotton charge or the air reservoir of a torpedo ready for launching. Leaving out all other considerations, if it is not possible to have submerged broadside discharges for ships of small or very limited displacements on account of its weight and inconvenience, we arrive at the conclusion that the protection of the tubes on board those ships in which the torpedo is the only or principal means of offence must be given up, but, on the other hand, that protection must be provided for those ships in which the weapon is a modest, if not a small, coefficient of their offensive power. For the first, the solution of the compromise must then be sought for elsewhere, that is, by protecting the torpedo-tubes from the effects of explosive projectiles and by arranging them in such a manner that the damage to the ship and personnel resulting from an accidental explosion of the charge or air-vessel of a torpedo may be reduced to a minimum. It is evident that this object can be attained with a small sacrifice of weight, and as an increase in the displacement of the ship generally results in a decrease of the value of the torpedo as a means of offence, whilst it augments the possibility of protecting the tubes in the manner above suggested, it follows that the broadside submerged discharge has not such an important advantage even with regard to protection as it is desired to claim for it. With the desire to make this notice as brief as possible, we leave out of account that the speed and manœuvring qualities of the ship affect the employment of the torpedo more than the complete protection of the launching tubes; we cannot but remark, however, that in the case of the submerged broadside apparatus, even if not very cumbersome, a large torpedo-room is required for its reception and working, just on the broadside of the ship, which constitutes a serious defect. This defect is still more serious when two torpedo-tubes are fitted symmetrically or nearly so, one on each side, as the damage caused by a torpedo or the ram of the enemy striking the ship in the neighbourhood of this chamber would be of the gravest possible character, and liable to be complicated to a disastrous extent by the possible explosion of a torpedo which chanced to be in the tube ready for launching. All this means that in order to protect the torpedo-tubes the protection of the hull has been made less efficient, with evident injury to two qualities very much more important, stability and the power to keep afloat.

Another observation of some importance might also be made, and that is that the efficiency of the submerged discharge depends to a much greater extent than the above-water system on the transmis-

sion of orders from the conning tower or observing station. In fact, it is necessary in the case of submerged tubes to have a voice tube for transmitting orders, another means of communication of some description for calling attention, also an electric circuit for discharging the torpedo; the latter can in no case be effected but from the upper deck, and as serious injury would be caused by firing the torpedo before everything was in order, safety arrangements must be provided to prevent any possibility of this accident occurring. All this is complicated enough even if everything is in order and has been tried before going into action, which it probably would be, and it may be added that, as air pressure is used for the discharge, and as complete reliance could not be placed on an accumulator, and it would not be advisable or convenient to have an air compressor in the submerged torpedo-room, other communications are required for the air service. As is known, the security of the apparatus for the transmission of orders and communications is a problem of the greatest practical importance on board modern ships, from the fact that a large number of fittings are necessary, and from the difficulty of having them both efficient and protected, so that this is evidently another element of inferiority with respect to the above-water system of discharge. We therefore conclude, that the consequences arising from an incomplete protection of the torpedo-tubes are not so serious as to require either the renunciation of any coefficient of the offensive power, or any reduction in the protection of the hull; that to demand complete protection for the torpedo-tubes of large ships, which would still preserve a large part of their offensive power, even when the tubes are destroyed, and to leave these unprotected in small ships, in which the offensive power would be completely annihilated with the destruction of their torpedo-tubes, does not appear to be either reasonable or logical. We would express as our opinion, on the contrary, that, admitting there can be only a limited protection for the above-water tubes, these should only be used at the sides of ships of all types, and that to prevent the limitation of the offensive power by their liability to destruction, their number should be increased; also that, if it is considered possible and advisable to fit a broadside submerged discharge on any type of ship, this should be no reason for any reduction in the number of the above-water discharges. In a word, that when the problem is preferred in such a manner that it is obligatory to choose either one or the other, the preference should always be given to the above-water discharge.

ON THE SUBMERGED DISCHARGE OF AUTO-MOBILE TORPEDOES IN THE LINE OF KEEL, AND SOME OTHER PROMINENT TORPEDO QUESTIONS.[1]

(Extract from an article by J. HEINZ, in the "Mittheilungen aus dem Gebiete des Seewesens," No. VIII of 1890.)

OF all kinds of submerged discharge as employed on board ships, if the right means are used, the bow discharge is, unquestionably, the one by which the most correct running is obtained, since it is the least liable to disturbing influences which can affect the torpedo.

Besides this, the method of discharge, as will be shown later on, is, in a certain direction, easily accessible to calculation, a very great advantage when dealing with the installation for a new ship. This affords an opportunity of proving that the use of well chosen axioms and theories may lead to a great saving of time and money, not to speak of the instructive generalizations on the practical solution of torpedo questions which may be obtained.

Experience in conjunction with theory indicates many disturbing causes which influence the path of the torpedo; we will here, however, deal principally with those which result from sudden and heavy blows on the horizontal rudders and the sharp deflection of the torpedo on its axis thereby produced. A superficial observation of the conditions of motion of torpedoes might, indeed, lead to the conclusion that the deflections of the nose of the torpedo out of the plane of discharge (if this expression can be allowed as analogous to the plane of fire in the case of artillery) have nothing in common with the sharp oscillations which take place; this conclusion, however, as we will endeavour as briefly as possible to show, is a false one. It must first be observed that when we lay a torpedo in the tank, which has been perfectly balanced for flotation, &c., for a state of rest, and set the engine in motion, it may happen that, by reason of the vibrations which are produced, the nose of the torpedo will deviate from the original plane of motion, and it follows from this that the balancing may be perfectly adapted for a state of rest, but not for one of motion. We can further consider the torpedo during its run in relation to its engine, which is in motion, as a rigid system of material points, in which, apart from the force due to its forward motion, there is also an inner force or forces the resultant of which produces disturbing elements in the direction of its path. These forces can be divided into horizontal and vertical components. The effects of the vertical components are counteracted by the action of the depth

[1] The above extract is printed here, as it is of interest in connection with the preceding article.—(EDITOR.)

PROFILE AND DECK PLA

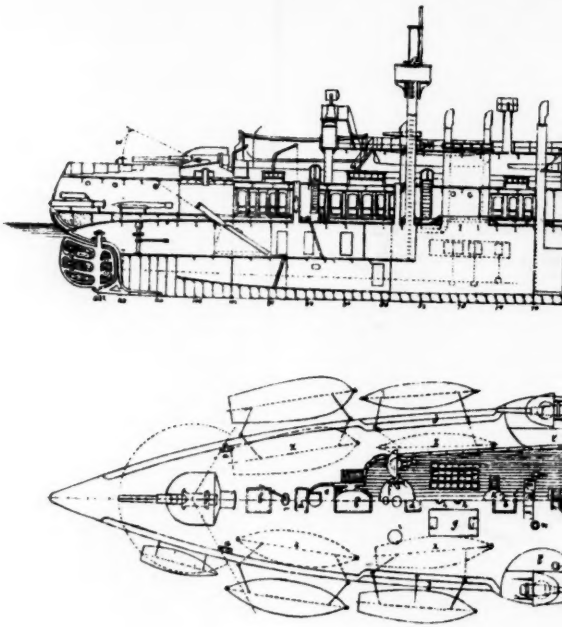
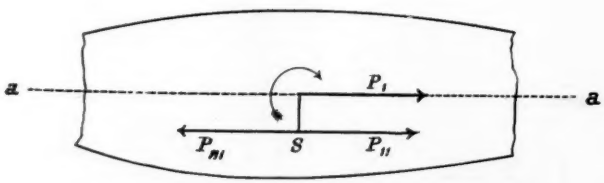


Fig. 1.



PLAN OF DUTCH ARMOURED RAM, TYPE A.[1]

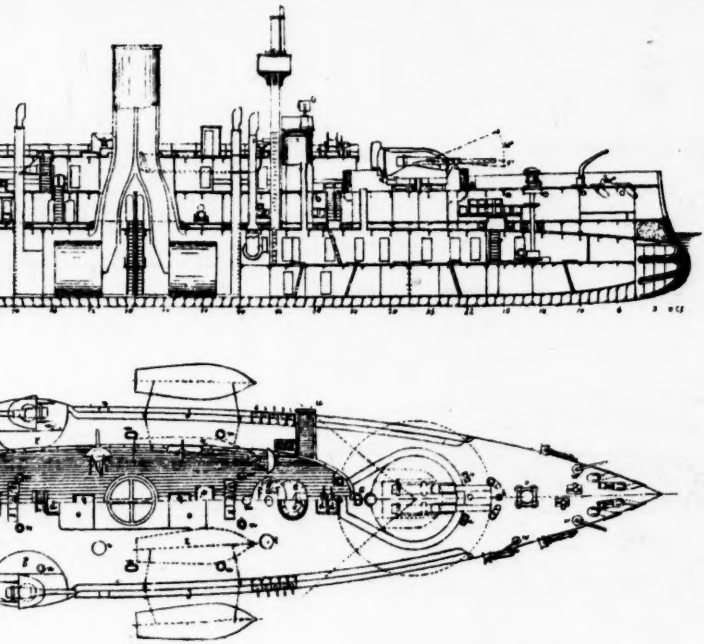
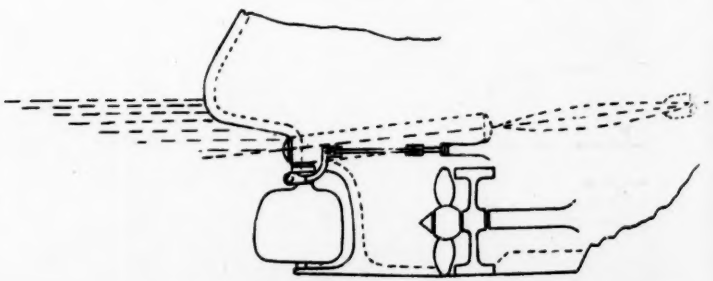


FIG. 2.



From "Mittheilungen aus dem Gebiete des Seewesens."

HARRISON & SONS, LITH. ST MARTINS LANE, W.C.

regulating apparatus, steering engine, and horizontal rudders, whilst the lateral deviations caused by the horizontal component are sought to be corrected by the setting of the vertical supplementary rudders; this is, however, as it is not necessary to insist on, a measure which may be considered rather in the light of a compromise than of a satisfactory corrective. In order to give an approximate explanation that the internal forces in the torpedo must influence the direction of its path, it is only necessary to picture to oneself the way in which the air passes through the air pipe from the air vessel, and through the reducing valve to the cylinders, and that the air pipe does not lie in a plane symmetrical with the torpedo, that the air cannot have an equal pressure throughout the whole length of the pipe, and that the reducing valve is set in motion up and down, with resulting forces acting and reacting in the same direction, &c. If the air pipe to the engines, reducing valve, and steering engine were so situated that they lay in a vertical sectional plane of the torpedo, the disturbing effects of the internal forces above mentioned would be fully taken up by the horizontal rudders, which is not the case, however, under the actual conditions.

The lateral position of the reducer and steering engines are concessions to economy of space, requirements which cannot be obviated, at least in the smaller types, so long as the present system is maintained.

As we have now indicated the disturbing forces which result from the internal forces and the vibrating movements of the torpedo, we will also point out a rather important force, the tendency of which is to cause a raising or lowering of the nose of the torpedo, and which is the result of an acceleration or retardation in the speed during the run. The analytical explanation is as follows:—

If the movement of the torpedo is accelerated, we can represent the force by the force P_{I} (Fig. 1) (= impulse *minus* resistance) acting in the direction of the axis, and above the centre of gravity S. If we imagine further two forces, P_{II}, P_{III}, acting at the centre of gravity, which in magnitude equal P_{I}, and acting in direction parallel to it, but in opposition to each other, the relative condition will be unchanged. We can, however, easily imagine the three forces combining under the influence of the accelerating force acting at the central axis, and a resistent force due to the inertia of the torpedo acting along the direction P_{II}, so as to form a couple represented by P_{I} and P_{IIII}, whose tendency is to turn the point of the torpedo downwards. If the force P_{I} be a retarding one, the inverse condition of things takes place, and the tendency of the couple is to bring the nose of the torpedo to the surface. The condition of acceleration is always present when the torpedo is discharged from the tube with a velocity less than its own normal speed due to the engines, and in order to counteract the tendency to dive, the horizontal rudders are locked up; this, however, is only a palliative, and not a cure, as the requisite adjustment cannot be made with certainty, and in case the rudders are released during the period of acceleration, there always occurs an alteration in the depth line, although often it is only slight,

forming the well known, so-called "hook," which can be perceived by watching the air bubbles.

The best locking position when adjusting torpedoes from the frame is not always "up": very often the horizontal position has the best effect; this does not affect the result, as the depth apparatus always comes into play during the acceleration period. After what we have said above, if the question be asked, which method of discharge favours the most correct running of the torpedo, it can only be replied, the submerged tube, placed nearly at the set depth of the torpedo, fixed horizontally, and the impulse so arranged that the torpedo enters the water with the same velocity as that of its normal engine speed. The horizontal rudders should be locked for a short distance, which can be determined best by successive trials. The analytical explanation of this condition of correct discharge consists in the fact that by it the force of the impulse is equal to the normal resistance, and possesses neither accelerating, retarding, nor turning moments. These conditions can be perfectly fulfilled by bow submerged discharge as well with the ship stationary as under way, and it is only necessary to fix the proper amount of impulse for every speed of ship, which can best and most quickly be done by experiment in conjunction with calculation; in this direction the Whitehead depth indicator may find useful employment, as well as the torpedo depth nets. The commencement of the trials consists in fixing the proper pressure in the impulse "reservoir" for the ship stationary, which is done practically as follows by the formula

$$L = \frac{v_a p_a}{k-1}\left[1 - \left(\frac{v_a}{v_n}\right)^{k-1}\right] = \frac{mv^2}{2} + N_o,$$

in which

L = work given out during the expansion of the air in the reservoir as far as the mouth of the tube.
v_a = volume of the reservoir.
v_n = v_a + volume of the tube.
p_a = pressure of air in reservoir.
k = coefficient = $\frac{\text{sp. heat at constant press.}}{\text{sp. heat at constant vol.}}$ = 1·41 for air.
v = velocity of torpedo after impulse.
m = mass discharged, *i.e.*, torpedo and water in tube included.
N_o = resistance overcome, from all causes.

The left side of the equation gives us the well-known thermodynamic formula for the work given out by an expanding gas between two given volumes, in the present case from the reservoir to the mouth of the tube, whilst the right side of the equation particularizes the employment of this work. It is of course understood that for the bow discharge under discussion, experiment has not only the first but the last word to say on the subject, and the above formula only gives us the means to fix very nearly by its aid the correct adjustments for the various changes in the speed of ship; so that the

experiments are expedited, and the delays and accidents caused by the torpedo jumping out of the water or diving to the bottom are avoided. The trials must begin, as already remarked, with the ship stationary, in which case the rudders are locked horizontal for a very short distance. The first object to be attained by the trials is to determine the proper impulse to give the torpedo the same initial velocity as that given to it by its own engine throughout its run. The necessary adjuncts for the experiment are the depth torpedo-nets, as well as the depth indicator attached to the torpedo, because every transition from impulse of discharge to impulse of engine can be observed from the changes in depth line, whether due to acceleration or retardation, in accordance with the principles developed above, and these changes can be read off by the nets or depth indicator. As a starting point, experience gained from similar installations can be used; for example, if the new tube be longer, the equation can be corrected accordingly on the left side in the relation $(v_a/v_a)^{k-1}$, and on the right by the increase of $\frac{1}{2}mv_2$, in consequence of its greater volume of water in the tube, and also taking account of the constant. When the datum has been determined for ship stationary, it should also be determined for various speeds, so that it can be decided with certainty for any change of 4 knots, and approximately for all speeds.

The stern under-water tube can only be satisfactorily introduced into twin screw ships, and the best installation is that on the model of the Italian man-of-war "Italia," in which the rudder head only extends sufficiently high above the rudder to enable an outside yoke to be fitted to it, the arms of which are connected to rods leading into the ship through stuffing boxes to the steering apparatus (Fig. 2). This arrangement not only places the whole of the steering gear in a position of security under water against the enemy's fire, but leaves room above for the under-water stern tube. The great importance of stern tubes, as well as the necessity of a rudder of large surface as deeply immersed as possible for modern ships, allows of the arrangement as shown in accompanying sketch. The under-water discharge for torpedoes has many other advantages besides those named; for instance, in launching from above water with a fresh side wind, it is well known that the torpedo is liable to suffer a considerable initial deflection, partly through the action of the wind itself and partly due to the disturbed surface of the water into which it enters, and also partly to the heel of the ship at the moment of discharge; the latter element of error is particularly observable from depressed tubes, and anyone can be readily convinced of its importance who has to carry out practice from the bow tube of a torpedo-boat in a rough sea. A range-finder for torpedo service is much required; it should be designed to be used by one person only, to give clear optical images, and with a small portion only of the enemy's ship necessary to be seen, such as the top of the mast above the smoke of powder, &c., or by night a single light, in order to calculate the distance from given data, or to get at the result by a step-by-step process. As regards protection by torpedo nets, it may be

observed that by the introduction of torpedoes of great speed and weight, the fight has taken a turn in favour of the torpedo, and, although the trials have been kept very secret, it is understood that, by means of experiments carried out by the Government with nets as fitted on board ship, it has been ascertained that the resistance of the nets is barely sufficient to afford protection against the 28-knot 14-in. torpedo, and during extended and exhaustive trials in France the torpedo sometimes succeeded in penetrating the nets. As an instance of the force of the blow given by the torpedo, it may be mentioned that the ordinary 14-in. torpedo has an energy of 2, the 28-knot 14-in. of 3, and the new 45-cm. of 6 metre-tons.

T. J. H.

THE GERMAN INSTRUCTIONS FOR THE EMPLOYMENT OF CAVALRY IN PIONEERING DUTIES IN THE FIELD.

THE official "Anleitung für Arbeiten der Kavallerie im Felde," recently published, gives instructions as to the pioneering duties in the field which the German cavalry are now expected to undertake for themselves. Numerous experiments have recently been carried out in Germany by the cavalry, and these Instructions may be looked upon as the practical outcome of those experiments.

To each cavalry division is detailed a mounted pioneer detachment, so that it will now have ready to hand both a trained personnel and a considerable amount of the necessary matériel; this will contribute greatly to the independence of the division, and to the rapidity of its action. Formerly, with the exception of a few tools, no material was carried, and consequently only such appliances were available as could be obtained on the spot.

The objects of the new Instructions are best described in the words of the book itself.

"1. The various tasks imposed upon cavalry in the field demand that it should be trained to a high degree of independence. Dependence on the other arms checks rapidity of action and surprise, and thereby deprives cavalry of an important factor of success.

"2. Cavalry must be in a position to carry out works of demolition and destruction in connection with railways, telegraphs, and other means of communication. As such operations will sometimes have to be carried out in presence of the enemy, and, as a general rule, within a very limited time, thorough previous training will be indispensable.

"Works of restoration will also be most necessary, in order to overcome such obstacles as may be interposed in the path to be traversed in reaching the desired goal. The ability to undertake such works also increases the field of employment of the cavalry arm.

"3. The above applies especially in the case of streams which are altogether without bridges, or the means of passage across which have been destroyed. A wide détour, with a view of effecting a passage, necessitates a deviation from the prescribed line of march, and may lead to marches involving the expenditure of more time and energy than would be required for the construction of such means of crossing as could be carried out in from one-half to a whole day. When the latter operation is not practicable, the river must be crossed by means of boats, ferries, or other means of passage, or by swimming.

"Occasionally it will be necessary to restore existing bridges or render them capable of sustaining a load.

"4. As ready-prepared material for the passage of streams, cavalry will be provided with collapsible boats, and will be accompanied by wagons stored with bridging material. In order to accelerate the passage of the river, and in view of occasions when the collapsible boats cannot be utilized, cavalry must be able to turn to account such unprepared matériel as may be available. To do this, as well as to make full use of the collapsible boats, must be the object of the instruction and of the practical exercises.

"5. Cavalry must understand how to increase the capabilities for defence of any locality by the employment of the most simple means and methods.

"It must also be trained to construct the necessary cooking and shelter arrangements in camp."

Then follow instructions prescribing annual courses of pioneer instruction for all cavalry regiments, and for the riding establishment, and dealing with the instructional staff and the material available for instruction.

Each cavalry regiment is to have two collapsible boats, together with the corresponding bridging material, all of which is *always to be kept in a state of readiness for service in the field.* Each of these boats is in three portions, and each boat, with the corresponding bridging material, cavalry telegraph apparatus, &c., and a certain proportion of explosives, is packed upon a four-horsed wagon; each regiment has thus two four-horsed wagons. These wagons must be able to accompany the cavalry everywhere. It is said that exhaustive experiments have been made with both wagons and boats, and that the results have been most satisfactory. Since a German cavalry division consists of six regiments, it will have in all 12 wagons. Each wagon has sufficient material for $4\frac{1}{3}$ yds. (4 m.) span of bridge.

A regiment has consequently sufficient for a span of	26 ft.	or $8\frac{2}{3}$ yds.	
A brigade has sufficient for a span of..	52 „	or $17\frac{1}{3}$ „	and
A division „ „ ..	156 „	or 52[1] „	

In addition to the explosives carried in the above-mentioned wagons, a cavalry division carries also a large quantity of explosives on two cavalry ammunition wagons, which also carry the tools for demolition purposes.

The pioneer detachment attached to a cavalry division will consist of 1 officer, 1 sergeant, 2 under-officers, and 27 pioneers, of whom 8 will be smiths, 8 carpenters, 4 masons, and 6 boatmen. They will be provided with portable intrenching tools, and will be carried as a rule in ordinary country carts. Additional intrenching and other tools, explosives, and telegraph material will be carried in the store wagon of the detachment.

In the event of the probable employment of the pioneer detachment, this fact is to be specially mentioned in the orders for the march.

The instructions are throughout simple and clear, and there are very numerous illustrations.

The regulations are arranged in three parts:—

Part I. General information.
„ II. Demolitions.
„ III. Passage of rivers (including instructions for swimming), and restorations and improvements.

(100.)

[1] The bridge has a width of 9 ft. 10 in. (3 m.), and permits of the passage of cavalry (mounted), and of field guns and wagons, either man-harnessed or drawn by two horses.

NAVAL AND MILITARY NOTES.

NAVAL.

Home.—Admiral Sir M. Culme-Seymour has been appointed to the Command-in-Chief of the Mediterranean Fleet, in place of the late Sir G. Tryon. He hoisted his flag on board the 1st class cruiser "Hawke," and, leaving England on the 5th ult., arrived at Malta on the 14th. The "Hawke" was originally intended to join the Mediterranean at the conclusion of the manœuvres.

The Court-martial for the trial of Captain Bourke and the surviving officers and men of H.M.S. "Victoria" assembled at Malta on the 17th ult., under the presidency of Admiral Sir M. Culme-Seymour. The other members of the Court were, Vice-Admiral Tracey, Captains Lake, Aldrich, Karslake, Hammick, Jeffreys, Langley, and Robinson. Captain Winsloe acted as Prosecutor, and Mr. Rickard, Secretary to Admiral Culme-Seymour, as Judge Advocate. The trial lasted until the 28th, when the Court fully acquitted Captain Bourke and the remaining officers and crew, and found that the loss of the "Victoria" was caused by collision with H.M.S. "Camperdown," due to an order given by the late Commander-in-Chief, Sir G. Tryon; the Court also recorded its opinion that the discipline and order maintained on board the "Victoria" to the last by every one were in the highest degree creditable to all concerned.

The 1st class torpedo-gunboat "Antelope" was launched at Devonport on the 12th ult. She is one of the last of the 18 vessels of this class ordered under the Naval Defence Act of 1889. They are somewhat larger than the "Sharpshooter" and her sisters, being 810 tons against the latter's 735. The engines and boilers of the "Antelope" are by Messrs. Yarrow, of Poplar, the four boilers are locomotive, and the machinery will develop 3,500 I.H.P. Her armament will consist of two 4·7-in. and four 3-pr. Q.F. guns, one bow and two double revolving broadside tubes. Her length is 230 ft., beam 27 ft., and her mean draught 8 ft. 9 in.

The new 1st class cruiser "Grafton" has successfully completed her trials, which took place off Plymouth and on the measured mile at Portsmouth. For the purpose of fully testing her capabilities, she was taken to Plymouth to enable her trials to be made in deeper water than is to be found off the Nore, and so prevent the drag incidental to all vessels of deep draught moving in comparatively shallow water. A continuous eight hours' full-power trial with natural draught was first made with the following mean results: with boiler pressure 154 lbs. per sq. in., 0·41 in. of air pressure in the stokeholds, vacuum 27 in., the engines developed 10,957 I.H.P., giving 96 revolutions per minute and a speed by log of 19·5 knots, the draught at the time being 23 ft. forward and 24 ft. 3 in. aft. The results of the four hours' forced draught full power were: boiler pressure 148 lbs. per sq. in., 1·16 in. of air pressure in the stokeholds, mean vacuum 26·7 in., revolution of engines 101·6 per minute, total I.H.P. 13,484, and speed of ship taken at half-hour intervals by log 20·5 knots. The trials were most satisfactory, giving an excess in power developed by the engines over that contracted for of 957 I.H.P. for the natural draught, and 1,484 I.H.P. for the forced draught trials.

The following is an abstract of the general orders and instructions for the naval manœuvres, which will, however, have concluded before the issue of this Journal:—

The objects of the manœuvres are:—On the part of one side to obtain command of the sea between Great Britain and Ireland, and on the part of the other to prevent this.

Scheme of Operations.—Each of two opposing naval forces—the Red and the Blue—is divided into two separate fleets, stationed a certain distance apart. The Red side is, on the whole, stronger than the Blue, but one of the Blue fleets is stronger than one of the Red, and the two Blue fleets, if united, are together stronger than either of the Red. Each Blue fleet at the beginning of operations is nearer to one of the Red than the latter is to the rest of its own side. A force of torpedo-boats is attached to the Blue side. The Red side is to do its best to bring its opponent to action, either with its own forces combined or not, at the discretion of the senior Admiral. If the Blue side has either been defeated or has been compelled to retire to a distance to avoid an engagement, and the Blue torpedo-boats have been destroyed or reduced to inactivity, the Admiral of the Red side is to report by telegraph if he considers that his side has gained command of the sea, so that a large expedition may be sent across it.

Manœuvre Field.—The limits of the manœuvre area were as follows:—On the north, 56° N. latitude; on the south, 49° N. latitude; on the east, the western coast of Great Britain and the south coast to 3° W. longitude; on the west, 13° W. longitude. The space between the parallel of 52° N. and 52° 10′ N., extending from the 13th meridian W. to the Irish coast, was to be considered a "forbidden belt," and was not to be crossed for manœuvre purposes.

The coast of Great Britain south of 56° N. latitude and round as far as 3° W. longitude was assumed to be the territory of the Red side. The coast of Ireland was assumed to be the territory of the Blue side. Islands belonged to the territory on the coast of which they are situated; the Isle of Man was included in the territory of Great Britain. The remaining coasts of the United Kingdom were assumed to be neutral. They were not to be visited for manœuvre purposes; and if, for reasons of navigation or other good cause, visits to them were found necessary, their neutral character was to be paid the respect which would be due to it in real war. Ships and torpedo-boats of one side were not to reconnoitre the ports assigned to the other during the period of the introductory cruises, or before permission was given by the Admiralty.

Places of Assembly.—The A Red Fleet assembled at Portland, the B Red Fleet at Milford Haven, the C Blue Fleet at Torbay, and the D Blue Fleet at Berehaven. The Blue torpedo-boats, with the ships to be placed at the torpedo-boat stations, assembled at Falmouth. The Blue torpedo-boat stations were as follows:—Larne, Belfast, Carlingford, Kingstown, Wicklow, Waterford. And in the following ports torpedo-boats were secure against capture:—Strangford, Dundalk, Howth, Wexford.

The manœuvre fleets have been composed of the Channel and First Reserve Squadrons, and the guard-ships of the home ports; the following ships were also mobilized in addition:—

Battle-ships—"Benbow," "Hero," "Conqueror."

1st class cruiser—"Blenheim."

2nd class cruisers—"Andromache," "Apollo," "Brilliant," "Sappho," "Terpsichore," "Tribune," "Indefatigable," "Intrepid," "Iphigenia," "Iris," "Naiad," "Æolus," "Forth," "Pique," "Rainbow," "Retribution," "Thames," "Spartan," "Latona," "Thetis," and "Pearl."

3rd class cruisers—"Barracouta," "Barrosa."

Torpedo-gunboats—"Circe," "Gleaner," "Gossamer," "Grasshopper," "Jaseur," "Jason," "Raven," "Salamander," "Sheldrake," "Skipjack," "Rattlesnake," "Seagull," "Spider," and "Curlew," and 24 torpedo-boats.

Hostilities commenced at 10 P.M. on the 27th ult., and were to conclude at 10 P.M. on the 6th inst.

France.—The aviso "Papin," which left Toulon on the 15th June to take the place of the "La Bourdonnais," lately wrecked in the East Indies, has been ordered to China to reinforce the squadron under command of Rear-Admiral Humann; in view of the

disturbed state of Tonquin and Cochin China, and possible difficulty with Siam, the Admiral has also been ordered to commission the gunboats "Aspic" and "Vipère" at present in reserve at Saigon; they are vessels of 463 tons displacement and carry two 6-in. and two 4-in. guns, with a complement of 80 officers and men. The 3rd class barbette cruiser "Eclaireur," which has been specially commissioned for the manœuvres, has returned to Brest, and been fully commissioned for active service; she will leave as soon as possible to reinforce the squadron in China. The "Eclaireur" is an old wooden ship of 1,600 tons, with engines of 2,408 I.H.P., an estimated speed of 15 knots, and a complement of 195 officers and men. Her armament consists of eight 6-in. guns and six mitrailleuses. ("Les Tablettes des deux Charentes.")

The squadron under Admiral Humann's orders in China consists of the following vessels: the armoured cruiser "Triomphante," bearing Admiral Humann's flag; this ship is quite out of date as an armour-clad, being built of wood, but she has an armour water-line 6-in. belt, with a 5-in. armoured central battery, and 5-in. armour on the barbettes in which her heavy guns are mounted, a displacement of 4,700 tons, and engines of 2,409 I.H.P., with a speed of 13 knots. Her armament consists of six 9-in., one 8-in., six 6-in., and eight machine guns, with a crew of 395 officers and men. The 3rd class cruiser "Forfait," also an old type of ship, built of wood, with a displacement of 2,321 tons, engines of 2,960 I.H.P., and a speed of 14·5 knots; her armament consists of 15 6-in. and eight machine guns, with a crew of 270 officers and men. The "Inconstant," a small despatch vessel of 870 tons, carrying four 6-in. and five machine guns, and a crew of 116 officers and men. Two gunboats, the "Comète" and "Lion," of 500 tons, of which the "Comète" carries two 6-in. and two 4-in. guns, while the "Lion" carries two 6-in. and four machine guns; both have crews of 75 officers and men. To these may be added a few small vessels for local duties in Cochin China and Tonquin, of which the "Lutin," a gunboat similar to the "Comète," has been lying off Bangkok for some time past; the other stationaries consist of the paddle despatch vessels "Alouette" and "Pluvier" of 570 tons, carrying six light guns and a crew of 71 officers and men; two paddle gunboats, the "Jacquin" and "Moulun," of 200 tons, carrying two 6-prs. and five machine guns; and five small river gunboats of 140 tons, the "Caronade," "Cimeterre," "Estoc," "Mutine," and "Arquebuse"; they each carry two 6-prs., three machine guns, and crews of 50 officers and men; there are also eight torpedo-boats divided between Saigon and Tonquin. ("Le Temps.")

The new torpedo-boat 177 has successfully completed her trials at Cherbourg and attained a mean speed of 23 knots; she is 118 ft. long, 13 ft. beam, with a displacement of 80 tons. ("Le Petit Var.")

The new 1st class battle-ship "Magenta" made a four hours' full speed trial of her engines under forced draught on the 26th ult. off Toulon; she maintained a mean speed of 16·2 knots, which was considered satisfactory.

The preliminary evolutionary cruise of the Active and Reserve Squadrons of the Mediterranean Fleet came to an end on the 10th ult., when the ships returned to Toulon to coal and prepare for the grand manœuvres. The preliminary cruise was devoid of any particular interest, but we may call attention to three attacks made on the fleet by the torpedo-boats. The first was made on the night of the 5th ult., upon the Active Squadron, which was anchored in the Gulf of Juan, and the second on the Reserve Squadron on the following night, which was anchored off Villefranche. The object in each case was to show if it was possible for a squadron, obliged to anchor in an open roadstead, to create round itself a fixed zone of light, thrown from the search-lights, through which no torpedo-boat could pass without being discovered, and which would thus form an effectual protection. Each ship

was directed to illumine a certain section of the anchorage, while the picket-boats were stationed to watch any dead angles. All the torpedo-boats were discovered as soon as they entered the limits of the zone, that is, at a distance of some 2,000 yards. The last attack was made on the fleet at sea on the night of the 7th, the Commander-in-Chief wishing to ascertain whether the torpedo-boats would easily discover a large squadron in the darkness, and, on the other hand, whether the scouts of the fleet would succeed in discovering and intercepting the enemy's attack. The squadron stood out into the offing in the evening, leaving the light ships in shore on the look-out, either to stop the torpedo-boats or lead them in a wrong direction. The torpedo-boats were grouped, two at Agay and five at Antibes; they weighed at 8 P.M., having received from the semaphores the exact position where the ships were last seen. At the time the fleet was only some 15 miles from the shore. After dark the ships proceeded without lights, the Admiral steering a zigzag course, first towards and then away from the land, the ships being in two columns in line ahead and thus covering a great deal of ground. The torpedo-boats from Agay were discovered by the cruisers and destroyed, but the others slipped through and safely gained the offing about 9.30 P.M.; they then spread like a fan and soon succeeded in getting touch of the squadron. They were discovered, and the ships opened fire, but very much at random and recklessly with regard to the position of each other, so that there is little doubt that one or more of them would in all probability have been successfully torpedoed. ("Journal des Débats.")

Some 3,000 Reservists have been called out and will complete their period of training between the 10th July and the 5th August. They were distributed among the following ships, which have been specially mobilized to receive them:—

At Cherbourg:—
The battle-ships—"Turenne" and "Lagalissonnière."
Coast-defence battle-ships—"Tonnant" and "Vengeur."
Torpilleurs-de-haute-mer—"Grondeur" and "Zouave," six torpedo-boats, and the armoured gunboat "Flamme," which is already partly manned.

At Brest:—
The coast-defence battle-ship—"Tempête."
3rd class cruiser—"Eclaireur."
And 6 torpedo-boats. The 1st class cruisers "Isly" and "Dupuy-de-Lôme," partly commissioned for their trials, have completed their crews also from the Reservists.

At Lorient 4 torpedo-boats, and at Rochefort 4 torpedo-boats.

At Toulon:—
The armoured gunboats—"Achéron." "Fusée," and "Mitraille."
The transport "Gironde" and 8 torpedo-boats, while the 1st class battle-ship "Magenta," on her trials, has also completed her effectives from the Reservists. ("Les Tablettes des deux Charentes.")

The Grand Manœuvres began on the 17th ult., and were to last a week. The general idea of the operations in the Mediterranean has been already given in last month's notes. We may add, however, that with a view of economizing fuel, the whole of the Active and Reserve Squadrons were not to take part in the operations: thus, the Reserve Squadron was to be represented, in its raid upon the Algerian coasts between Bougie and Cape Bon, by all its cruisers and an armour-clad division composed of the "Colbert," "Terrible," and "Indomptable," under the orders of Rear-Admiral Prouhet. Similarly, the Active Squadron (the defenders) sent out all its cruisers to scout, accompanied by the battle-ship "Dévastation," under the orders of Rear-Admiral Gadaud. When the scouts came in touch with the enemy, a division composed of the battle-ships "Hoche," "Neptune," and "Marceau" was to proceed to sea to bring the enemy to action. There were finally some torpedo operations between the two squadrons, and the whole concluded by a general action between the two fleets. During the manœuvres the ships were not

to proceed at more than two-thirds speed. Vice-Admirals Vignes and Boissoudy took no part personally in the operations, but acted as Umpires. All the semaphore and signal stations on the coasts of Provence, Corsica, and Algeria were mobilized. ("Le Yacht.")

In the Channel the principal manœuvres also began on the 20th; the scheme of operations being somewhat similar. A French squadron lay at Cherbourg, ready to put to sea as soon as the enemy's squadron should have been signalled as entering the Straits of Calais. In moving against the enemy, the squadron was to maintain its touch with the shore, so that it might receive intelligence, without delay, of any point within the 1st Maritime Arrondissement which was threatened with attack. The *rôle* assigned to the enemy's squadron was to try and pass the Strait without being perceived, and to ravage the French coasts, at the same time avoiding a general action. The English coasts were considered neutral. The French squadron had the assistance of the shore batteries and of the "Défense Mobile," while all the semaphore and signal stations were mobilized. The declaration of war was made at noon on the 20th, by which time both fleets were to have taken up the positions assigned to them. Hostilities came to an end at noon on the 28th, and were divided into two parts, although the operations in each case were the same; the enemy had first to pass the Straits between 4 A.M. and 4 P.M., and then again between 6 P.M. and 2 A.M. The enemy's squadron, under the command of Rear-Admiral Barrera, consisted of the battle-ships "Victorieuse," "Furieux," and "Tonnerre"; the cruisers "Isly" and "Épervier"; and the torpilleurs-de-haute-mer "Turco," "Grenadier," and "Grondeur." The defending squadron was under the command of Vice-Admiral Lefèvre, and consisted of the battle-ships "Suffren," "Requin," and "Fulminant"; the cruisers "Eclaireur" and "Surcouf"; the aviso-torpilleurs "Lance" and "Salve"; and torpilleurs-de-haute-mer "Veloce," "Défi," and "Lancier." The enemy's squadron was supposed to take up its position in the North Sea, 150 miles from the entrance of the Straits, and there was to be a short rest between the two parts of the manœuvres, during which Admiral Barrera would be allowed to anchor off Dunkirk. ("Les Tablettes des deux Charentes.")

In an early issue of the Journal we shall give as full details as can be procured of the manœuvres both in the Channel and the Mediterranean.

Germany.—There was lately launched from the Shichau Yard at Danzig a new protected cruiser called the "Gesion." She will have a displacement of 4,000 tons, and is of the same type as the "Irene" and "Prinzess Wilhelm." Her engines are to develop 9,000 I.H.P., which is expected to give a speed of 20 knots. In addition to her 3-in. armoured deck, she will have round the water-line cofferdams filled with cellulose. She will have two fighting masts, and her principal armament will consist of six 6-in. Krupp Q.F. guns; what smaller guns she will carry has not yet been definitely settled, but she will have six torpedo-tubes. ("La Marine de France.")

Holland.—The following are some of the principal features of the new armoured rams, Type A[1] (Plate 24).

Length between perpendiculars	263 ft. 6 in.
„ over all	275 „ 6 „
Beam	46 „ 6 „
„ including sponson for 6-in. guns	50 „ 3 „
Displacement „ „ „	3,400 tons.
Mean draught (with all stores on board)	16 ft. 8 in.

Protection is afforded by a steel belt, 6 in. thick, for two-thirds of the length of the ship, tapering to 4 in. at the bow and stern, and reaching from 3 ft. 3 in. below to 6 in. above the water-line. A 2-in. armoured deck extends from 3 ft. 3 in. below the water-line at the sides, and rises amidships to 1 ft. above. The combings of

the funnel and engine-room hatches have 6-in. armour, while cofferdams filled with cellulose run round the whole length of the ship in rear of the armour-belt, and also round the hatchways. The barbette for the two heavy guns and the conning tower are protected by 10-in. armour. The armament will consist of 2 8-in. guns in a barbette forward on the upper deck, 1 8-in. gun aft with a steel shield, and a 6-in. gun with steel shield each side amidships. Upon the hurricane deck will be 6 6-pr. Q.F. and 2 1·5-in. Q.F. guns, in the fighting tops 4 1·5-in. Q.F. guns, all of which are fitted with steel shields. The barbette guns have a training arc of 280°, the axis of the guns being 16 ft. 3 in. above the water-line, and 6 ft. 6 in. above the upper deck. The 8-in. gun aft has an arc of training of 240°; the 2 6-in. broadside guns fire fore and aft. Of the 6 6-prs. upon the hurricane deck, the 2 foremost fire from right ahead to 75° abaft the beam, the 2 after ones from right astern to 75° before the beam, while the 2 centre ones have an arc of training of 260°. The magazine and shell rooms for the barbette and the foremost Q.F. guns are forward, the others aft, the ammunition being supplied through three armoured tubes to the upper-deck guns, while that for the Q.F. guns on the hurricane deck comes up through the steel military masts. There will be three torpedo-tubes, one in the stern and one on each broadside; the torpedo-room is aft, below the armoured deck, where are also the compressed-air reservoirs and pumps. There will be two sets of vertical, direct-acting, triple-expansion engines, which will indicate under forced draught 4,500 H.P., which is expected to give a speed of 16 knots. The bunkers will carry 250 tons of coal; and the crew will consist of 260 officers and men. ("Mittheilungen," from "Marineblad.")

Italy.—Almost all the disposable ships of the Italian fleet are taking part in the manœuvres this year. Two squadrons have been finally formed as follows.—The Active Squadron ("Squadra Permanente") under the command of H.R.H. the Duke of Genoa, Chief of the Staff Captain Palumbo.

1st Division:—
Battle-ships—"Lepanto" and "Ruggiero di Lauria."
Torpedo-cruiser—"Euridice" and torpedo-boats 103, 111, 114, and 131.

2nd Division (Rear-Admiral Corsi):—
Battle-ships—"Italia" and "Andréa Doria."
Torpedo-cruiser—"Iride" and torpedo-boats 123, 124, and 125.

3rd Division (Rear-Admiral Gonzales):—
Battle-ships—"Dandolo" and "Affondatore."
Torpedo-cruiser—"Goïto" and torpedo-boats 57, 62, 115, and 158.

The torpedo-avisos "Aquila" and "Sparviero" and the cistern-ship "Tevere" are also attached to this squadron.

II. The Evolutionary Squadron under the command of Vice-Admiral Accinni, Chief of the Staff Captain Bettolo.

1st Division:—
Battle-ships—"Re Umberto" and "Duilio."
Torpedo-cruiser "Minerva" and torpedo-boats 59, 65, 72, and 94.

2nd Division (Rear-Admiral Marza):—
Protected-cruisers—"Fieramosca" and "Vesuvio."
Torpedo-cruiser "Aretusa" and torpedo-boats 76, 77, 91, and 139.

3rd Division (Rear-Admiral Quigini):—
Battle-ship—"Castelfidardo."
Protected-cruiser—"Stromboli."
Torpedo-cruiser—"Urania" and torpedo-boats 71, 73, 74, and 137.

The torpedo-avisos "Falco" and "Avvoltoio" are also attached to this squadon.

The supreme direction of the manœuvres has been confided to Vice-Admiral Bertelli, who has hoisted his flag on board the "Trinacria." ("Journal des Débats.")

It has been ordered that bow and stern net defence is to be abolished as being impossible of employment for a ship in motion, and a special committee was lately appointed to study the best method of protecting these parts. This confirms the opinion of many with regard to net protection, and it is a fact that the nets do not form an efficient defence and are a serious impediment. It is maintained by many experts that speed and efficient scouting service constitute the best and perhaps the only practical means of defending a ship against torpedo-boat attack.

According to the latest information, it is proposed in France to abolish net defence not only in part, but entirely; for the reason that, as it is absolutely impossible to protect by this means the extremities of a ship under way, these parts must remain unprotected, and as the side nets alone will cause a great reduction in speed, the ship will be in much greater peril from a torpedo-boat attack; the latter rely on their superiority in speed for successfully attacking the parts undefended, especially on the bow, as they are then exposed but a short time to the zone of heavy fire, the risk being proportionately less in the ratio that their speed exceeds that of the ship. It may, therefore, well happen that, instead of being an efficient protection, the net defence may rather favour the attack by torpedo-boats; while as regards defence at anchor, it is maintained that, should a ship be unfortunately forced to anchor in a dangerous roadstead, she could not consider herself out of danger solely in virtue of her net defence, and this is all the more true because practical experiments have shown that this defence will not stop the torpedo, even when nets of a special type and exceedingly strong and heavy are employed. ("Riv. Marittima.")

By a Royal Decree, the 1st class battle-ship "C" at present building at the dockyard at Castellamare is to be called the "Emanuele Filiberto," and the two 2nd class armoured cruisers "E" building at Spezzia and "S" at Castellamare are to be named "Carlo Alberto" and "Vetto Pisani." ("Giornale Militare per la Marina.")

The protected cruiser "Liguria," a sister ship of the "Etruria" and "Lombardia," was launched on June 8th, from the Ansaldo yard, at Sestri Ponente. She is built of steel, is 262 ft. 6 in. long, 39 ft. 4 in. beam, and, with a displacement of 2,280 tons, has a mean draught of 15 ft. She is protected by a 2-in. steel deck below the water-line. Her armament will consist of four 15-cm. (5·9-in.) guns, six Q.F. 12-cm. (4·7-in.) guns, 16 Q.F. 3-pr. and 1-pr. guns, two machine guns, and four torpedo-tubes. Her engines are to develop 6,500 I.H.P. and to give a speed of 19 knots, and she will carry 500 tons of coal. ("Italia Militare e Marina.")

Russia.—The squadron under the command of Vice-Admiral Kaznakoff, consisting of the "Dmitrij Donskoi" flag-ship, the "General-Admiral," and the "Rynda," after being joined by the "Pamjat Azova," will proceed to the Mediterranean and form the Mediterranean Squadron. It is now many years since Russia has maintained a permanent squadron in that sea, as for some time a single ship, mostly stationed in the Piræus, has been the only representative of the Russian Navy. Vice-Admiral Kaznakoff will probably, in the autumn, be succeeded by Rear-Admiral Makaroff. ("Gazette de Saint-Pétersbourg.)"

United States.—An important trial of armour plates came off on the 11th ult. at the Government proving grounds on the Potomac River, below Washington. First, a 9-in. nickel-steel plate, made by Messrs. Carnegie for the side-armour of the monitor "Monadnock," received from an 8-in. rifled gun three conical Holtzer projectiles, weighing 250 lbs. each. The first shot, which had a velocity of 1,400 ft., penetrated the plate and the oak backing 11·7 in.; the second, with a velocity of 1,683 ft., went through the plate and also 3 ft. of oak backing, losing itself in the earth behind; the third, with a velocity of 1,536 ft., penetrated the plate and 14·5 in. of the backing. The plate well withstood the strain, no cracks were perceptible, and it fully met the conditions required for acceptance.

Next, a 17-in. nickel steel curved plate, which was made by the Bethlehem Iron

Company, and was a sample of the barbette plates for the battle-ship "Indiana," was put to a severe trial. It is the heaviest plate yet tested, its dimensions being 8 ft. 4 in. high by 12 ft. 1 in. long, and its weight 31½ tons. It had three 850-lb. conical Carpenter shells fired at it from a 12-in. rifled gun, the muzzle of which was 319 ft. distant from the plate. The first shot, with 1,322 ft. velocity, penetrated 16·6 in.; the second shot, with 1,495 ft. velocity, went through the plate and also penetrated 3 in. into the oak backing; while the third, which had a velocity of 1,858 ft., went through the plate, through 3 ft. of oak backing, and through the earth behind, when it was deflected and lost, after ploughing away for a distance of several hundred yards. No cracks were shown under this terrific strain. Both consignments of plates were accepted, but the makers did not succeed in winning the premium of 30 dollars a ton offered, if punctuation were successfully resisted. The contract price is 675 dollars per ton. The four projectiles which were not lost showed no substantial injury. The energy of the heaviest shot was equal to 21,600 ft.-tons. The results have given great satisfaction. ("The Times.")

On June 10 the battle-ship "Massachusetts" was launched from Messrs. Cramp's yard at Philadelphia. She is of the same type as the "Indiana," which was launched from the same yard last March, and her sister ship the "Oregon." We hope before long to give full particulars of these three powerful battle-ships.

An electric launch has been built for the armoured cruiser "New York." This little craft is 30 ft. long, 6 ft. 10 in. beam, and her draught 22 in. She is to have a speed of 6 or 7 knots, is propelled by a screw, to which the motive force is imparted by a motor with 64 storage batteries, placed beneath the inner planking.

It is also proposed to employ electricity for working the turrets of the cruiser, and it has proved necessary to alter the arrangements for the magazines, which have been found to become dangerously heated in consequence of their vicinity to the stokeholds. ("Le Petit Var.")

MILITARY.

Austria-Hungary.—The new portable army tent, as proposed by the Technical Administrative Committee, has been finally approved. In the first instance it will be supplied to the dismounted troops, and subsequently to the cavalry and artillery. This tent, which weighs 16·3 lbs., is intended for two men, and is entirely carried by them in equal loads. It can be fixed as a closed tent or as a single screen against sun and wind. According to the "Allg. Mil. Zeitung," the equipment is to be tried by two infantry regiments during the great manœuvres in Hungary.

Belgium.—According to "La Belgique Militaire," the number of troop horses per squadron is to be raised from 125 to 135. It is proposed that in case of war 2 independent cavalry divisions shall be formed, each consisting of 16 squadrons; further, each infantry division would have attached to it a detachment of 2 squadrons, for which purpose the existing 5th squadrons would be used; and on mobilization fortress squadrons are intended to be raised. In order to provide for the latter formations, each regiment has, on paper only, a 6th squadron, for the manning of which a roll is constantly to be kept up of persons on the active and leave lists.

Denmark.—The "Neue Mil. Blätter" (quoting from "Das Pferd") gives the following account of experiments recently carried out in France, and subsequently in Denmark by Veterinary Surgeon Marlot, with the object of deciding whether horses should be fed before or after watering. As an animal is nourished not by what it merely eats, but by the food it digests, the first object of the experiments was to establish the effect on the process of digestion produced by the presence of a quantity of water in the stomach while the food was still there. In the Agricul-

tural School of the French Department of Yonne a horse was fed with 4 litres of oats and immediately watered. Shortly afterwards it was killed. About 1 litre only of oats was found in the stomach, swimming in the water, the rest having been washed into the intestines and so become lost for purposes of nourishment. A second horse was first watered and at once fed with 4 litres of oats. After a quarter of an hour it was killed, when the whole of the oats were found in the stomach, and were seen to be already under the influence of the digestive juices. Similar experiments conducted by Veterinary Surgeon Marlot, without the animal being killed, showed that a mass of undigested oats was always evacuated if water was given immediately after feeding. He therefore concludes that horses should always be watered before feeding, and further recommends that they should not be fed at once after work, but should first be allowed to rest a little, then given a little hay, and afterwards be fed with oats.

France.—The "Revue du Cercle Militaire," No. 27, states that the infantry are about to carry out interesting and novel exercises in the use of explosives. According to the latest instructions for field work, each regiment of infantry, or battalion forming a corps, is to be exercised every year in the use of explosives for the destruction of railways and for demolitions of various kinds, and to this end each of the units specified is now allowed an annual supply of 100 pétards and 75 detonators. The details of the practical exercises to be carried out with this material are to be prescribed by the army corps commanders.

The provisions of the new law of cadres, adopted by the Chamber of Deputies on June 27, are given in full in the "Revue du Cercle Mil.," No. 27.

The carrousel at the Cavalry School of Saumur will be held on August 21, and will be preceded and followed by a day of racing. To any one interested in the present state of military equitation in France, a visit to these exercises cannot fail to be instructive.

The "Spectateur Militaire," of 15th July, commenting on the report on the recruiting operations of 1892, remarks as follows:—"It shows a sad diminution in the number of young conscripts. There were 22,822 fewer than in the preceding year (class of 1890), only 277,425 of the class of 1891 having drawn lots, as against 300,247 in the previous year. This constant diminution in the amount of our population is calculated to make all good Frenchmen uneasy. It demands imperiously the attention and study of philosophers and legislators. The causes of this decrease are various, and are intimately connected with considerations of morality and social economy. . . . We cannot but deplore, from the point of view of the contingent defence of our country, this progressive diminution of our resources in men. It is of no use to perfect our armament and raise new fortifications if we have not sufficient men to garrison the latter, and have not the means of raising field armies, if not superior, at least numerically equal, to those of the enemy." Of the 277,425 men liable to service, after deducting exemptions, &c., from all causes, there were incorporated in the army 181,872. Under the head of education, the "Spectateur" remarks that, although the proportion of young men who can neither read nor write diminishes every year, it does so but very slowly, being still 7·05 per cent. in 1892, a fact which is difficult of explanation in view of the law regarding obligatory primary instruction. This subject was alluded to in our Military Notes for March, in which also will be found, for purposes of comparison, the percentages of illiterates in the German and Russian armies (0·45 and 66·7 respectively).

In previous "Notes" attention was called to the fact that medical officers are no longer permitted to undertake private practice. A similar restriction has now been placed upon the fencing instructors of the army. In consequence of civil professors having objected to the military instructors competing with them in private practice, commanding officers have received instructions not to authorize

their *maîtres d'armes* to give lessons to civilians, except upon the demand or official assent of the mayors of towns, &c.

"La France Militaire," No. 2472, gives interesting details of experiments which have been conducted in the Laboratory of the Intendance Committee, in Paris, with the object of determining the suitability of aluminium vessels for containing liquids, articles of food, &c. Pure aluminium seems to be hardly affected by even sour liquids, but the presence of the small quantity of iron which is nearly always present in the best commercial aluminium seems to favour chemical action, and produces slight discoloration of some liquids. Wine, beer, cider, and other liquids were left for months in contact with the metal, and were not injuriously affected, and although the metal was slightly eaten away in most cases, the conclusion was arrived at that aluminium vessels could be used with safety for drinking bottles and culinary articles. Soup and cooked meat can be left in such vessels for 24 hours without any apparent effect, and in any case less effect was produced on aluminium by the various liquids experimented with than on the metals in ordinary use, such as iron, copper, zinc, and tin. Lengthened exposure to the atmosphere appears to produce no effect, so that in this respect there is thought to be no obstacle to the extensive use of the metal for an almost endless variety of military purposes.

Germany.—The "Rev. Mil. de l'Étranger" for June gives a short account, taken from the "Hamburger Nachrichten," of the guns exhibited by the Krupp works at the Chicago Exhibition.

According to the 21st Report of the Kriegerbund (Association of Veterans) the association numbers 194 groups, comprising 7,954 societies throughout the Empire, and a total of 657,438 members.

Recently published statistics seem to indicate a check, if not a positive decline, in the development of the German population. It would appear that the number of children under 10 years of age has decreased by 4½ per cent. in the ten years from 1880 to 1890, and as there has been no increase in infantile mortality during that period, it follows that the number of births must have diminished. ("Rev. du Cercle Mil.")

The following extract from the proposed law regarding the peace strength of the German Army contains the provisions which are of most general interest:—

Art. 1. The peace effective of the German Army in men and lance-corporals for the period from 1st October, 1893, to 31st March, 1899, is fixed at 479,229 as a yearly average. One year volunteers, under-officers, officers, surgeons, and officials are not included in these numbers.

From the 1st October, 1893, the infantry will be formed in 538 battalions and 173 half-battalions, the cavalry in 465 squadrons, the field artillery in 494 batteries, the foot artillery in 37 battalions, the pioneers in 23 battalions, the railway troops in 7 battalions, and the train in 21 battalions.

Art. 2 provides, among other things, that during the period of their liability to service in the standing army the men of the cavalry and horse artillery are bound to serve with the colours without break for the first three years, all other men for the first two years.

The "Spectateur Militaire" states that a number of *tentes-abris* have recently been manufactured under the orders of the War Ministry, which are presumed to be intended for the use of the cavalry. They are said to be sufficiently large to cover not only men but their horses also.

According to the same journal, a scheme will come into operation in the autumn for instructing a certain number of officers and intendance officials as interpreters.

Officers of troops garrisoned to the east of the Elbe will be taught Russian and Polish, and officers of other corps French. Each army corps will receive a special allowance for this purpose. Examinations will be held in the spring of every year under the superintendence of the Chief of the Great General Staff. The candidates for interpreterships will be required to write an essay and to carry on a conversation in the language studied, and passed interpreters will be required to undergo a fresh examination in the language every five years. Those who possess special aptitude will be eligible to receive allowances to enable them to visit the country concerned.

The new military law was accepted by the Reichstag on the third reading by 201 against 185 votes. The "Rev. du Cercle Militaire" gives the following table, taken from the Supplementary Budget, showing what will be the effective of the German Army in the last six months of 1893–94, the figures in parentheses being the augmentation resulting from the new military law (included in the preceding numbers):—

Officers	22,458 (1,796)
Under-officers	77,864 (10,912)
Men	479,229 (59,198)
Medical officers	2,068 (228)
Paymasters, veterinary surgeons, armourers, saddlers, &c.	2,833 (433)
All ranks	584,452 (72,567)

The following vacancies were occasioned in the last six months in the German army by death or retirement. These details are of interest, as showing the many changes now going on among the superior officers of the German army:—

Generals.—10 (including the commanders of the Guard, IVth, VIIth, and Xth Army Corps, the Inspector-General of Foot Artillery, the Governor of Cologne, and the Commandant of Berlin).

Lieutenant-Generals.—11 (including the commanders of the 4th, 10th, 13th, 29th, 34th, and 35th Divisions).

Major-Generals.—24 (including the commanders of the 7th, 8th, 12th, 13th, 16th, 23rd, 32nd, 35th, 36th, 40th, 44th, 49th, 68th, 69th, and 72nd Infantry Brigades, the 2nd Guard, 12th, 13th, 30th, and 37th Cavalry Brigades, and the 17th Field Artillery Brigade).

Colonels.—20 infantry, 10 cavalry, 1 artillery, and 2 engineers (including the commanders of the 1st, 16th, 28th, and 34th Cavalry Brigades).

Italy.—The War Minister has decided that the velocipedes which were issued to the troops for experimental purposes are to be retained by them and permanently taken on the establishment of field equipment. ("L'Esercito Italiano.")

Spain.—The question of the armament of the Spanish troops has at last been settled, and the "Rev. du Cercle Militaire" gives the following *résumé* of the decree signed by the Queen Regent, dated 21st June:—The artillery is authorized to purchase directly from Messrs. Loewe, of Berlin, 20,000 rifles and 50,000 carbines of the Spanish Mauser system M/1892, and 10 million cartridges for the same, and in virtue of this purchase the Government acquires the right to manufacture 50,000 rifles of the same system at the national factory of Oviedo.

The Marine Infantry has recently been reorganized. The details of the new organization are given in the "Revue du Cercle Militaire," No. 30.

Switzerland.—The fortress artillery will in future be provided with aluminium water-bottles and wooden drinking-cups.

The "Rev. du Cercle Militaire," No. 30, quoting from the "Allgemeine Schweiz. Mil. Zeitung," gives an interesting account of the Krnka-Hebler tubular bullet. The most satisfactory form of the projectile is said to be conical at both ends, the width of the central tube being about two-fifths of the calibre. Fired from the German rifle M/88, the relative resistances in the air of various bullets experimented with were as follows:—

1.	Ordinary bullet	1,000
2.	Solid bullet, with flat base and ogival point	541
3.	„ with both ends ogival	216
4.	Tubular bullet „ „ „	89

Fired from the rifle of 5 mm., and with an initial velocity of 750 m., these figures were respectively 1,000, 463, 285, and 66. The improvement in flatness of trajectory is shown by the following figures:—At 1,000 m. with the German rifle M/88, of 7·9 mm., the beaten zone with the ordinary bullet is 42 m., and with the same rifle the tubular bullet gives a beaten zone of 218 m., but with the rifle of 5 mm. calibre, the tubular bullet gives a beaten zone of 400 m., or ten times that given by the German rifle and bullet in actual use. Owing to the diminished weight of the bullet, the gas pressure and recoil are considerably reduced. It is stated that a very trifling alteration (chiefly in the sights) is required in order to enable the new projectile to be used in existing small-bore rifles.

The annual report of the Swiss Military Department for 1892 speaks in the highest terms of the tinned meats produced by the manufactory at Rorschach (St. Gall), the superiority of which over the American and Argentine preserved meats appears to be fully established. The dislike to these rations hitherto shown by the troops is rapidly disappearing, and, indeed, the tinned meats are much appreciated in the central and eastern parts of the country. The same success has not attended the issue of the excellent biscuits which are occasionally substituted for part of the bread ration, but it is confidently expected that in course of time the prejudice against them will gradually disappear. These biscuits are manufactured by the "Anglo-Swiss Biscuit Company, at Winterthour."

FOREIGN PERIODICALS.

MILITARY.

Militär-Wochenblatt.—No. 58. "Advanced Positions in the past and in the future." "Promotion in the Russian Army." "Horse Breeding in France." No. 59. "Advanced Positions in the past and in the future" (*continued*). "Von Löbell's Jahresberichte." "The New French Law of Cadres." "What is the best way of incorporating the young Remounts, and of protecting them from Influenza?" No. 60. "The Wars of Frederic the Great" (criticism of the work issued by the Great General Staff). "Advanced Positions in the past and in the future" (*concluded*). "The Summer Exercises of the Troops in the Military District of St. Petersburg." "The Pattern Cavalry Barracks at Vincennes." No. 61. "An Officer's Expenses 200 years ago." "The French Naval Budget for 1894." "The New Swedish Army Organization." No. 62. "Thoughts on the Training of Cavalry." "Remarks on Krupp's Catalogue for the Chicago Exhibition." "The Supply of the Troops in the Russian Fortresses on the Western Frontier." "Remarks on the Article, 'Horse Breeding in France,' in No. 58." No. 63. "The Musketry Instructions for the New Russian Rifle." "Notes on the Danish Army

and the Fortification of Copenhagen during the Year 1892." No. 64. "French Experiments with the object of determining the Presence of Glanders by the Subcutaneous Injection of Maléine." No. 65. "Training and Education: a Psychological Study." "Pioneering Duties of Cavalry in the Field." No. 66. "Training and Education" (*concluded*). "Pioneering Duties of the French Infantry." (This notice of the latest French Instructions gives the number of tools carried by companies, dimensions of regulation trenches, breastworks, &c.) No. 67. "A Brave Act in the Battle of Neerwinden, 29th July, 1693." "Review of the Latest Inventions and Discoveries, Chemical and Technical, affecting Military Art." "The Bridging Trains in France." "A Society for English Naval History."

Beiheft zum Militär-Wochenblatt.—Hefte 5 and 6. "Military Notes made during a Residence in the Caucasus and in Persia," by the late General v. Grolman. Hefte 7 and 8. "March-Dispositions and Marching-Power in Napoleon's Time," by Captain Frhr. von Freytag-Loringhoven. "The Russian Military System, as it is and as it ought to be," extracted from a recent Russian work bearing a similar title, by Captain A. von Drygalski.

Neue Militärische Blätter.—July—August. "Colonel de Ponchalon's 'Souvenirs de Guerre (1870—1871).'" "The Changes in the Organization of the Bulgarian Army since 1892." (A very complete account.) "The Canal between the Two Seas." (The proposed canal from the Atlantic to the Mediterranean.) "A Sketch of the Battle of Lübeck." "In a Snow-storm. Recollections of the Herzegovina in 1882." "The French Railways in the Direction of Belfort, and French Chauvinism, as viewed by a Neutral." "General Skobelev and the Moral Element." (Founded on Episodes in the Russo-Turkish War.) "Extracts from 'Anweisungen zum Reitunterricht fur die Kavallerie,' &c."

Jahrbücher für die Deutsche Armee und Marine.—July. "The Campaign of 1809 in the Tyrol, on the Salzburg and Bavarian Southern Frontier." "Moltke and Radetzky." "The Franco-German Paper War regarding the Armoured Turret." "The Present State of the Art of Field Fortification and the 'Feldbefestigungs-Vorschrift.'" "Martial Law (Military Law in Time of War)." "The Projected Law regarding National Shooting Clubs and the Military Training of Youths in Italy." "The Patrolling Duties of Cavalry." "The Fortress of Montroyal."

Organ der Mil.-Wiss. Vereine.—Heft 7. "The Present Condition of the Art of War." This number contains a useful list of recent military works in various languages (November, 1892, to April, 1893).

Deutsche-Heeres Zeitung.—No. 57. This number contains the first instalment of a new essay by Captain Fritz Hoenig, entitled "The Fights of Boiscommun and Lorcy on the 24th and 26th November, 1870."

Journal des Sciences Militaires.—July. "Strategy of Marches" (*continued*). "Ought Metz to have been quitted in 1870?" "Objectives, Directions, and Fronts" (*continued*). "Cryptography" (*continued*). "The Tactical Instruction of Officers" (*continued*). "The Campaign of 1814" (*continued*).

Revue Militaire de l'Étranger.—July. "The New German Military Law." "The Grand Manœuvres of 1892 in Italy." "The Silladar Cavalry in India" (from "United Service Magazine").

Spectateur Militaire.—1st July. "Discipline." "The Position of the Officer in Germany." "Tactics of the Wars of the Middle Ages" (*continued*). "Les Cents-Suisses" (*continued*). 15th July. "The Forthcoming Infantry Drill Regulations." "A Year's Column Work in Algeria. Souvenirs of General Lacroix' Expedition in 1871–72."

Revue du Cercle Militaire.—No. 27. "Notes on the Mobilization of the Italian Army." "The New German Cavalry Drill Regulations" (*continued*). No. 28.

"The Text of the Proposed German Military Law." "The New German Cavalry Drill Regulations" (*continued*). "Notes on the Mobilization of the Italian Army (*concluded*). No. 29. "The New German Cavalry Drill Regulations" (*concluded*). No. 30. "The Turkish Hamidié Cavalry." "The New German Instructions for the Pioneering Duties of Cavalry." "The Tubular Krnka-Hebler Bullets." No. 31. "The Events in Siam." "The Projected Reorganization of the Italian Army." "Bridging Material of the German Cavalry." "Principal Provisions of the New German Law regarding the Divulging of Military Secrets."

Revue de Cavalerie.—July. "Letters of a Cavalryman. The French Cavalry compared with the German." "The Supply of Men and the Remounts of the Cavalry of the Grand Army in 1806–7" (*continued*). "L'Instruction Pratique sur le Service de la Cavalerie en Campagne," of 1884. (Suggestions for bringing the French text book on detached duties of Cavalry up to date.) "The Cavalry at Traktir, 16th August, 1855." "The Paces of Horses revealed by the Experimental Method" (*continued*).

Revue d'Artillerie.—July. This number contains a very interesting description of a portable pocket instrument termed the "Règle topographique," invented by Captain Delcroix, which appears to be well adapted for solving problems in map-reading, sketching on horse-back or on foot, judging distance, measuring vertical and horizontal angles, &c. It seems to be worthy of attention.

Revue du Service de l'Intendance Militaire.—May—June. "The Administration of the Austro-Hungarian Army" (*continued*).

Revue Militaire Suisse.—July. "Extracts from the Annual Report of the Swiss Military Department for 1892" (*continued*). "Critical Observations on the Organization of the Swiss Infantry" (*continued*).

NOTICES OF BOOKS.

The Steam Navy of England: Past, Present, and Future. By H. WILLIAMS, Chief Inspector of Machinery, R.N. London: W. H. Allen and Co. 12*s.* 6*d.*

The series of essays which form the valuable book before us is the work of an officer who has risen to high distinction in his own branch of the Service, and whose views on the subjects on which he writes, founded as they are on an experience acquired during a service career of more than 30 years, mostly spent in holding important positions, will be read with profit, and be received with respect by all who take an interest in naval matters. The author devotes the first four chapters of his book to discussing the "Future Training of our Seamen and Stokers," which is undoubtedly becoming one of the most important questions in connection with the personnel of the navy. Referring to the large number of non-combatants who go to make up the complement of modern war-ships, amounting as they do in some of the battle-ships to something like 41 per cent. of the whole crew, Mr. Williams proceeds to elaborate with great care a scheme, by which not only will the stokers in the future be trained and become efficient gunners, but seamen in their turn will be taught to perform all the duties of stokers. He proposes, and here most naval officers will agree with him, that the present system of entering stokers shall be abolished, and that the future stokers shall be entered as boys at the same age as the present seamen class, and that, in

fact, all the boys entered in the future shall be brought up as "all-round men," fit either to perform their duties as gunners and in other seamen's work, or to efficiently work in the engine-room or stokeholes. Naturally, Mr. Williams is an advocate for doing away with the present training-squadron, and would have no instruction wasted, as he considers it, on masts and sails. It is not our place here to enter into or take sides in that thorny question; we will content ourselves by merely observing that the mass of foreign naval opinion is against the rising school in our Service which would abolish the training aloft of our blue-jackets, which has undoubtedly done so much in the past to make our men the handy all-round men they have so often shown themselves to be. "Seamen can only be made at sea, and by learning to handle ships under sail," is the opinion strongly held by French naval authorities among others, and there is no idea in France of abolishing instruction in masted ships. At the same time it cannot be denied that Mr. Williams carries with him the opinion of many of our ablest officers, and whether they agree with him or not, naval officers will read his essay on the "Training of our Seamen" with great interest, and it will certainly bring home to the minds of all the necessity which exists for some radical change in the organization of the personnel of our ships. We cannot close these remarks on the opening portion of Mr. Williams' book without calling attention to his very pertinent observations as to the necessity which exists of "Naval officers of the present day possessing a good general knowledge of the construction of their ships, and a scientific insight into the effect on stability of flooding by damage, or otherwise, of one or more of the compartments into which modern ships are divided." In view of the late lamentable loss of the "Victoria," his remarks on this important question are prophetic and, we trust, will in the future bear good fruit. The second portion of the book is devoted to the "Machinery of War Ships," and deals mainly with the vexed question of forced and induced draught; although to a great extent technical, these chapters are full of interest, and will well repay careful reading. The same may be said of Part III, in which the question of "Naval Engineering" is discussed at some length. With forcible and clear reasoning the author lays great stress upon the absolute necessity of having highly-trained engineer officers in our war-ships; he also deprecates, and most officers will agree with him, any idea of lowering the standard of qualification of these officers, or of looking upon them merely in the light of "Engine-drivers." Part IV contains some miscellaneous chapters, of which the most important and interesting are the ones on "Coal Endurance" and "The Engine Room Complements of Her Majesty's Ships"; and the book concludes with a well-written and carefully-prepared summary of the contents. In conclusion we can compliment the author on the skill and courage with which he has laid his views before the public and grappled difficult questions, and we trust that his book will be as widely read and carefully studied as it unquestionably deserves to be. (1.)

Experiences of a Prussian Officer in the Russian Service during the Turkish War of 1877–78. By RICHARD, GRAF VON PFEIL, Major and Battalion Commander in the Grenadier Regiment Crown Prince Frederick William (2nd Silesian), No. 11. Translated from the German (4th edition) by Colonel C. W. BOWDLER. London: Edward Stanford. 1893. 10*s.* 6*d.*

Colonel Bowdler has done good service to the British Army in putting before it in an English dress Count von Pfeil's "Experiences" during the Russo-Turkish War of 1877–78, as, with the exception of Lieutenant Greene's "Sketches of Army Life in Russia," a work written by one who saw the campaign more or less through the spectacles of the Russian Headquarter Staff, his translation is the only work in English from the pen of a soldier dealing with the inner life of the Russian Army during that war. Count von Pfeil, after serving in the Prussian Guards during the campaign of 1870–71 and for some time afterwards, was given a commission in the Russian Army, joined a regiment of the line engaged in holding the Shipka Pass, had an opportunity of visiting the Headquarter Staff of the army at Gorni Studen, served on the staff of Prince Mirski during the passage of the Balkans, the battle of Shipka, and the advance on Adrianople, and was finally

transferred to a regiment of the Russian Guard in front of Constantinople, so that his recollections have all the merit of variety, and his opportunities of observing all phases of Russian army life were great.

Of recent years much has been done to improve the Russian Army, to perfect its organization, armament, equipment, and training, and to quicken the process of putting it in the field. But when we read of all these improvements, and contemplate the vast array of figures which represent the forces which Russia is said to be able to place in the field, we are too prone to forget that, ater all, an army is made up of men, that these men are led by officers, and that on the professional attainments, intelligence, and bravery of the latter the ultimate success of the army depends. Organize and arrange as one may, the nature of the officers cannot be changed in 15 or 20 years any more than the Ethiopian can change his skin, and we are convinced that until the nature, social standing, and professional acquirements of the Russian officers are very much improved, the same faults will be found and the same difficulties will occur in the wars of the future as in 1877-78. Here is the weak point, the Achilles' heel, of the whole vast fabric of the Russian army, and it is just as well that British officers should know it.

Count von Pfeil's sketches paint the Russian officer as he was and now is, and we are sure that no British officer will lay down this well-written and readable translation without a regret that there is not more of it. G.

Chronological History of the Royal Palace of Whitehall from the Time of Cardinal Wolsey, 1514. Revised edition, 1893. London: Forster, Groom, and Co. 6*d*.

This little pamphlet, which is illustrated with a sketch of Whitehall as it appeared before the fire of 1691, and of the building as it will appear after the completion of the new wing, contains a brief but very complete account of all the historical events with which the new home of the Royal United Service Institution is intimately associated.

List of Recent Foreign Books (Military).

Aide-Mémoire de l'Officier d'État-Major en Campagne (corrected to May, 1893). Official. Paris: Lavauzelle. 5 fr.

La Guerre de Demain.—Stratégie et Mobilisation. By General Morel. 56 pp. Paris: Lavauzelle, 1893. 1 fr. 25 c.

La Guerre de Demain. 2e partie: La Guerre en rase campagne. By Captain Danrit. 2 vols. Paris: Flammarion, 1893. 7 fr.

La France et l'Angleterre en Asie. By P. Lehault. Vol. i. Indo-Chine. 1892. Paris: Berger-Levrault. 10 fr.

La Nouvelle Loi Militaire Allemande (being an Appendix to "La Puissance Militaire des États de l'Europe"). By Captain J. Molard. Paris: Plon, Nourrit and Co. 1893. 0 fr. 50 c.
(A comparison of the French and German Armies.)

Pingot et Moi. Journal d'un Officier d'Artillerie. By Art Roë, 1893. Paris: Berger-Levrault. 3 fr. 50 fr.
(An interesting work, written with the object of showing the ideal relations which should exist between officers and their men.)

Kriegsgeschichtliche Beispiele. Im Anschluss an den an den königlichen Kriegsschulen eingeführten Leitfaden der Taktik. By Colonel O. von Lettow-Vorbeck. 3rd Edition, with 54 Maps, &c. Berlin: Schenck, 1893. 4 mks.

Die Kriege Friedrichs des Grossen. Herausgegeben vom Grossen Generalstabe. 1st Part (in 3 Vols.). "The First Silesian War, 1740—1742." Vol. i, with numerous Maps, &c. 1890. 16 mks. Vols. ii and iii. 1893. 21 mks. Berlin: Mittler.

Kurzer strategischer Ueberblick über den Krieg 1870-71. By Lieutenant MOSER. With 7 Coloured Maps. Berlin: Mittler, 1893. 1 mk. 50 pf.

Mit Prinz Friedrich Karl, Kriegs- und Jagdfahrten und am häuslichen Herd. By HEROS V. BORCKE (Author of "Two Years in the Saddle"). Berlin: Mittler, 1893. 6 mks.

Sammlung militärwissenschaftlicher Vorträge und Aufsätze. In zwanglosen Heften. Düsseldorf: Schrobsdorff, 1892.

This series of pamphlets (price 50 to 80 pf. each) promises to be very interesting. The titles of the first five numbers are as follows:—

"Erlebnisse bei der Einnahme von Le Mans" (1 to 13 January, 1871), and "Ruhetage in Tours" (February, 1871). By General BERENDT.

"Heer und Nationalkraft." By SCHILLER-TIETZ.

"Wie man durch die Blokade läuft" ("Recollections of the American War"). By Major SCHEIBERT.

"Der Uebergang des Korps Lecourbe über den Rhein bei Stein am 1 Mai, 1800. By Lieutenant R. GÜNTHER.

"Die Kriegsausrüstung der Offiziere" and "Über die Ernährung im Biwak und auf dem Schlachtfelde."

German and Austrian Military Works published in 1892. (There is a very complete list in the "Neue Mil. Blätter" for July, 1893.)

(NAVAL.)

Essai de Stratégie Navale. Par le Commandant Z—— et H. MONTÉCHANT. 550 pp. With Plates. Paris: Berger-Levrault, 1893. 10 fr.

LIST OF BOOKS SUPPLIED TO H.M. SHIPS.

SHIP'S LIBRARY, FOR OFFICERS ONLY.

Title of book.	Author's name.	1st. Complements of 400 and upwards.	2nd. Complements of 200 and under 400.	3rd. Complements under 200.
Blake, Robert	H. Dixon	1		
Botany, Manual of	Balfour	1	1	
Collingwood, Life of	Clark Russell	1	1	
Coral Reefs	Darwin	1	1	1
Crimean War	Hamley	1	1	1
Dalhousie	Trotter	1	1	1
Dictionary, English International	Webster	1	1	1
„ French	Smith & Hamilton	1	1	1
„ German	Flügel	1	1	1
„ Italian	Millhouse	1	1	1
„ Spanish	Lopez & Bensley	1	1	
„ of Dates	Haydn	1	1	1
Dundonald's Autobiography	....	1	1	
Earthquakes	Milne	1	1	1
Elementary Physiology, Lessons in	Huxley	1	1	
Elements of Astronomy	Ball	1	1	1
Encyclopædia	Chambers	1	1	1
Engineer's Pocket Book (formulæ)	Molesworth	1	1	
English Constitution and Government	Amos	1	1	1
English Men of Action Series: Dampier, Cooke, Drake, Rodney	....	1	1	
Fishes	Gunther	1	1	
Fragments of Science	Tyndall	1		
Gazetteer of the World	A. K. Johnston	1	1	1
Geology, Text Book of	Geikie	1	1	
Heat, a Mode of Motion	Tyndall	1	1	1
Historic Towns: Cinque Ports, New York, Boston	....	1	1	
History of England, 449—1880	Bright	1	1	1
„ Civilization	Buckle	1		
„ India under Victoria	Trotter	1		
„ Our Own Times, Jubilee Edition	J. M'Carthy	1		
Hydrographical Surveying	Wharton	1	1	1
Indian Mutiny	Malleson	1	1	1
Influence of Sea Power on History	Mahan	1	1	
International Law	Hall	1	1	1
Introduction to Historical Geography of British Colonies	Lucas	1	1	

Title of book.	Author's name.	1st. Complements of 400 and upwards.	2nd. Complements of 200 and under 400.	3rd. Complements under 200.
Island Life	Wallace	1	1	1
John Davis, Arctic Explorer	Markham	1	1	1
Lectures on Light	Tyndall	1	1	1
Life of Lord Hawke	Burrows	1		
Life of Sir William Hoste: Service Afloat	....	1	1	
Magellan and the Pacific	Guillemard	1	1	1
Mechanics, Applied	Cotterill	1	1	
Midnight Sky	Dunkin	1	..	1
Mineralogy, Systematic	Bauerman	1	1	
Natural History, Riverside	....	1		
,, ,, New	Duncan	..	1	
Naval Warfare	Colomb	1	1	1
,, Annual	Brassey	1	1	1
Nelson, and Naval Supremacy	Clark Russell	1	1	1
Nelson's Last Captain	Phillimore	1		
Origin of Species	Darwin	1		
Photography, Treatise on	Abney	1	1	1
Physics, Treatise on	Ganot	1	..	1
Physiography	Huxley	1	1	1
Preliminary Survey	Gribble	1	1	
Samuel Pepys	Braybrooke (Editor)	1		
Short Studies on Great Subjects	Froude	1	1	
Sound	Tyndall	1	1	1
Star Atlas	Proctor	1	1	1
Story of Nations Series: Germany, Turkey, Holland, Russia, Mediæval France, Carthage	....	1	1	1
Telegraphy	Preece & Sivewright	1	1	1
Telephone, The	Preece & Maier	1		
Universal History	Cassell	1	1	1
Volcanoes	Judd	1	1	1
Weather	Abercromby	1	1	
Wellesley, Marquis	Malleson	1	1	1
Winds, Popular Treatise on	Ferrel	1	1	